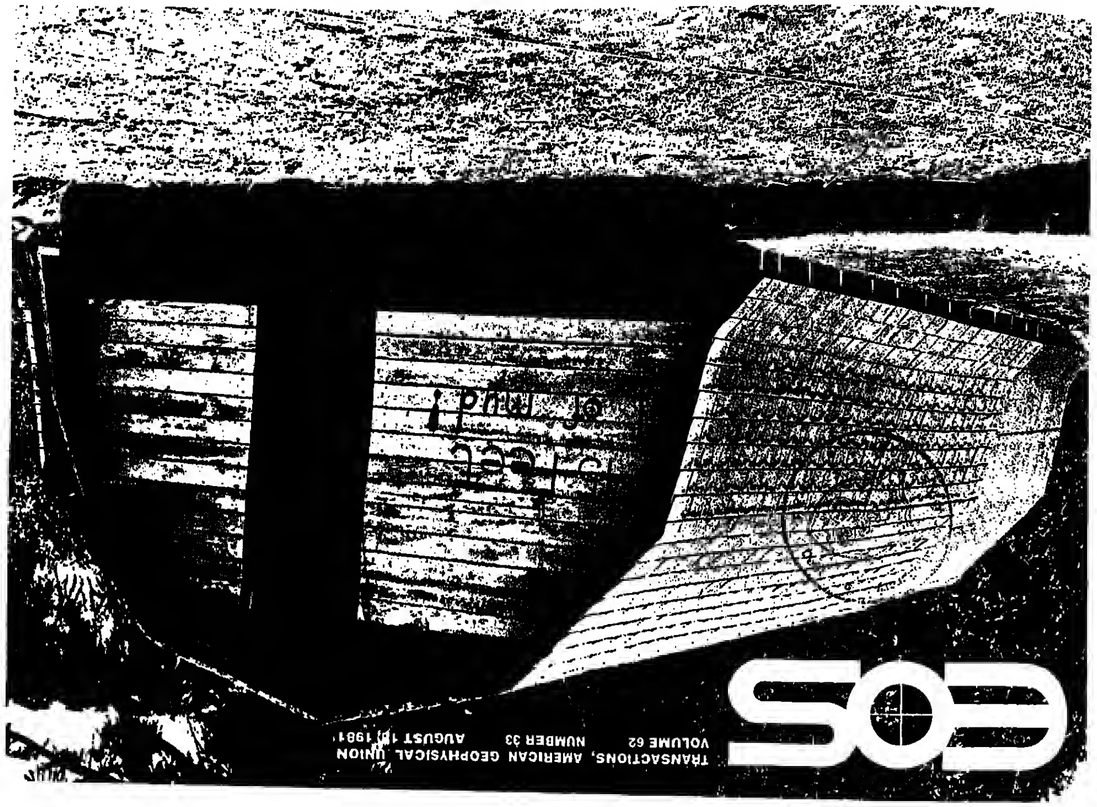

EOS, TRANSACTIONS, AMERICAN GEOPHYSICAL UNION VOL. 62, NO. 33, PAGES 625-632 AUGUST 18, 1981

Editorial

Dues and Contributions

You will see a new line on the dues notice that you will receive shortly. It calls attention to AGU's fundraising efforts. The needs of AGU, like those of any other organization or individual, have risen both with inflation and with the maturity of our activities. Dues have not risen since 1968. Instead, AGU has chosen to rely on pricing its services, such as journals and meetings, on a cost recovery basis; thus, only those who participate in an activity are charged for it. In this way, dues, which could be an economic barrier at the entry level, can be kept as low as possible.

In recent years, inflationary increases have reduced the Union's ability to build an adequate reserve. As a result we are less certain about AGU's ability to continue to serve our disciplines in the face of economic and technological challenges. In particular, I am concerned about the effects of changing technology on scholarly communication. Pioneering in areas involving expensive technology should be left for the most part to our big brothers, such as the American Chemical Society, the American Institute of Physics, and the Institute of Electrical and Electronics Engineers. But we must work with them in supporting roles and have the resources to take up desirable options as they are proved viable; otherwise, we will be buried. The loss to science and scientists would be irreparable, for without the revenue from our communication activities there is no AGU.

The AGU-GIFT fundraising effort was launched in order to build a reasonable reserve for the Union. Articulation of the need for the reserve and objectives of the drive were the first steps taken by the Council Committee on Financial Resources and the AGU-GIFT Steering Committee. The primary objective of the current drive is to raise $1,000,000 through the membership over the 5-year period ending in 1985. When this effort is well underway an additional goal will be set for institutional support of the Union. You might ask 'How can the membership of the Union give $1,000,000?'

The AGU has over 13,000 dues-paying members. To speak in terms of averages for a moment, $1,000,000 spread over 13,000 members during 5 years requires only $15 from each member each year. Of course, averages in a case like this are almost meaningless except as a rough guide and as an aid in visualizing the problem. Surely, this calculation makes our goal seem somewhat less staggering.

In an effort to give all members an easy way to contribute, an entry has been made on each dues notice specifying a voluntary contribution of $10. This is a strictly voluntary contribution, and the amount is only a suggestion. The important thing is that each member share in the effort. A high level of participation is essential to providing continuing momentum for future efforts, especially the attempt to gain institutional support. It is my hope that for every member who feels that the contribution is too high for his or her particular circumstances there will be another who will be moved to give more. More than half of the AGU-GIFT goal could be met in this way over the next 5 years.

These contributions are, in some ways, similar to a voluntary increase in dues, but they differ from dues in a very material way. Every contribution made in this way or through supporting membership will be credited as a contribution to AGU-GIFT. Dues are used for current operating needs, while AGU-GIFT is building a reserve that will prepare AGU to meet future challenges. You may specify, if you like, that your contribution be dedicated to the endowment fund or to another special purpose. With your participation, the Union will gird itself for whatever tomorrow brings. Join every other AGU member and show your support with a contribution that reflects the value of AGU to you.

Fred Spilhaus

News

Dynamics Explorer Launched

The Dynamics Explorer A and B (now 1 and 2) spacecraft were launched into coplanar orbits from the Western Test Range at Vandenberg Air Force Base in California on August 3, 1981, at 0958 UT. Although the orbits of the spacecraft are lower than expected, the change should not impede attaining the project's goals.

'All orbital parameters are nominal except the apogees, which, due to a short second burn of the second stage, are lower than planned,' said Robert A. Hoffman, project scientist, at the Goddard Space Flight Center.

DE-1 will move in a high orbit, carrying video cameras to photograph the changing patterns of the northern lights. Meanwhile, DE-2 will skim above the atmosphere from pole to pole. In its lower orbit, it will move much faster and will make many more observations of the polar regions. Also, it will pass through the upper atmosphere and ionosphere to measure the intense, external disturbances.

The orbit of the DE-1 is 575 km by 23,163 km (instead of 24,875 km) and that of the DE-2 is 609 km by 1012 km (instead of 1300 km). All major objectives of the mission should be achieved with the actual orbits, Hoffman told *Eos*. In addition, instrument activation is proceeding as scheduled with all instruments on the DE-2 expected to be ready for operations before the end of August.

The spin axis of DE-1 is being magnetically torqued, Hoffman explained, to orbit normal, after which the long wire antennas and instrument booms will be erected and the spin rate adjusted to about 10 rpm. Completion of these activities is expected in mid September.

All spacecraft systems are operating normally, Hoffman reported, except one of two battery charger control circuits on DE-2. Nevertheless, the DE team believes the battery will be functional. 'Operational workarounds are being developed to utilize this battery,' he said.

The goal of the Dynamics Explorer program, according to NASA, is to enhance the understanding of the processes by which energy from the sun, in the form of light waves and matter, flows through interplanetary space, enters the region around the earth controlled by the magnetic forces from the magnetosphere, and eventually is deposited in the earth's upper atmosphere. This phenomenon produces the aurora, affects radio transmission, and might influence basic weather patterns. Information collected during the mission will lay the foundation for a four-satellite mission, dubbed Origin of Plasmas in the Earth's Neighborhood (OPEN), scheduled for the middle of the decade. ☒

Geobarometers Clarify Crustal Doubling

Two University of Chicago geochemists report what they believe is confirming evidence for the crustal-doubling theory. The theory, which could explain the great height of the Himalayas, says that parts of several continents were once buried to a depth of 35 km, the entire thickness of the earth's crust.

Robert C. Newton, professor of geology, and Dexter Perkins III, a postdoctoral research associate, report in an article in the July 15 *Nature* that they have developed geobarometers, or formulas, that relate the compositions of minerals in rock to the pressure at which the rock crystallized. By determining the pressure, they can calculate the depth at which the rocks were formed. Newton and Perkins base their work on granulite rocks (found in Europe, Asia, North America, and Australia), which contain pyroxenes, plagioclase, garnet, and quartz. Thermodynamic measurements,

(News cont. on page 634)

EOS

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Cover. Low and high confining stresses are explained by the Griffith theory of brittle fracture of rocks. This sketch depicts Griffith loci for low (P_2) and high (P_{c2}) confining stresses, critical crack lengths C_{c1} and C_{c2} for these conditions, and elastic loading followed by a conditionally stable sliding path 1 and an intrinsically unstable sliding path 11. An excerpt from AGU's latest addition to the Geophysical Monograph series (24), *Mechanical Behavior of Crustal Rocks—The Handin Volume.* For more information turn to page 635.

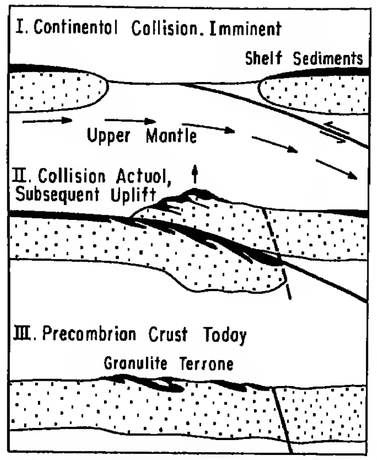
Diamonds in the Outer Planets

The results of space exploration over the last 2 years have provoked considerable and widespread interest, among geoscientists, in the interiors of the outer planets. Even new data on remote Uranus and Neptune are becoming available, and so it is not unusual to expect a round of new speculation on their interior compositions and properties. In a very recent article in *Nature* (*292*, 435–436, 1981), one of the most eminent theoretical physicists in the field of gas thermodynamics at high pressure has developed a model of the layered structures of Uranus and Neptune. Marvin Ross of the University of California (Lawrence Livermore National Laboratory), taking into account the knowledge that the outer planets have an inner layer, or mantle, consisting of forms of water, methane, and ammonia (in addition to various proportions of hydrogen plus helium in solar abundance), suggests that there could be a process that forms diamonds and metallic compounds. In the *Nature* article, entitled 'The Ice Layer in Uranus and Neptune—Diamonds in the Sky?,' Ross makes a serious analysis of existing shock wave and theoretical data on methane, carbon, and hydrogen with which he compared the interior of Uranus (Neptune is very similar, he says). The results could have far reaching implications in the theory and understanding of the solar system. The postulation properties of the mantles of Uranus and Neptune could cause magnetic fields and the generation of radio waves.

What Ross suggests is that the 'ice' mantles of Uranus and Neptune, being under intense pressure and temperature (roughly 2000–7000 K, 0.2–5.0 Mbar), have dissociated into carbon and hydrogen, which could form metallic diamond crystals. Under these conditions water and ammonia become fully ionized, a condition that would mean the absence of molecular compounds. In Uranus and Neptune, Ross concedes that in a fluid of ionized water and ammonia the diamonds would be gravitationally unstable and would settle to form a dense layer.

Ross notes that magnetic fields could form in the mantles of Uranus and Neptune and that the motion of charged particles trapped in the magnetic fields would generate radio signals. Radio signals may have been detected from Uranus. The full consequences of Ross' findings are not yet assessed. He points out that carbon in Uranus and Neptune constitutes 17% of the mass. A conducting (metallic) carbon layer could have a significant effect.—*PMB* ☒

(News cont. from page 633)



These three panels show the progressive changes of two continental plates as they undergo crustal doubling. (See explanation in the text.)

taken over a period of years by Newton and Ole J. Kleppe, a physical chemist at Chicago, were used to derive the geobarometers.

Newton and Perkins found that the surface granulites from the worldwide sampling sites had been subjected to pressures of about 8 kbar, or about that which would be expected at the base of normal earth crust, about 35 km deep.

'The most plausible method for sending those rocks to such depths and retrieving them is through crustal doubling,' Newton said.

Crustal doubling occurs when continents on the earth's plates collide, as shown in the first panel of the diagram. One continental plate subducts for a short distance under the other. A master fault, depicted as the dashed line in panel 2, or a series of less conspicuous faults can accommodate the uplift, Newton explained. But because the continents are buoyant, he continued, high elevations are created; great topographic heights, such as those of the Himalayas, are reached quickly with respect to geologic time. Granulite terrane that once covered the subducted plate is then buried under a full thickness of the earth's crust. These greatly elevated areas erode quickly, as seen in panel 3, leaving the previously deep-buried rocks exposed.

This exposed granulite terrane consistently shows evidence of having been buried and subjected to pressures of 8 kbar. They also are rich in continental shelf sediments, Newton told *Eos*. There is no question, he added, that these granulites long ago had been deposited on the surface.

Newton and Perkins also report that, 'Calculation of pressures for several terranes shows that the geobarometers yield reasonable and consistent results for the entire range of crustal pressures.' Other geobarometers, such as the one based on the reaction of cordierite to garnet, sillimanite, and quartz, are limited by the pressure ranges to which they can be used accurately.—*BTR* ⊠

National Technology Foundation Proposal

A bill that would combine sections of the National Science Foundation and the Department of Commerce into a National Technology Foundation was introduced in June by Rep. George E. Brown, Jr. (D-Calif.), chairman of the House Science and Technology Committee. Purpose of the foundation would be to 'promote the advance of technology, technological innovation, technology utilization, and the supply of technological manpower for the improvement of the economic, environmental, and social well-being of the United States.' The bill has been sent to congressional committee.

'Among other things, the National Technology Foundation would recognize the importance of engineering and help harness its potential,' Brown told the House.

The foundation would comprise a National Technology Board, a director's office, and six functional offices: Small Business, Institutional and Manpower Development, Technology Policy and Analysis, Intergovernmental Technology, Engineering, and National Programs.

Under the bill, nine offices, services, and agencies would be transferred to the foundation. The National Bureau of Standards, the Patent and Trademark Office, the National Technical Information Service, the Office of Industrial Technology, and the Center for the Utilization of Federal Technology would move from the Department of Commerce. The National Science Foundation would turn over to the proposed foundation its Directorate for Engineering, Division of Industrial Science and Technological Innovation, Intergovernmental Programs Section, and the Office of Small Business Research and Development.

The bill (H.R. 3749) is a revised version of a similar bill introduced in the 96th Congress. The newer version takes into account the reorganization of NSF to include an engineering directorate.—*BTR* ⊠

NSF and NASA Budgets Increased

Research budgets of several of the federal government agencies were increased significantly over the Reagan administration's requests in the House of Representative's appropriations bill H.R. 4034. These budgets had been removed from the Reagan administration's omnibus reconciliation bill, and thus there were worries expressed that certain research funding could be in jeopardy. The rationale was that because the requests were voted on individually on the floor of the House, many sections of the budgets would be subjected to extra scrutiny, which would lead to more cuts.

The National Science Foundation (NSF) budget request had been cut and reordered by the Office of Management and Budget (OMB) by making sharp reductions in programs of the social sciences and in programs of science and engineering education. There were fears that these programs would be reinstated to the original request level, at the expense of the budgets of other research activities. These fears materialized, but only momentarily. Efforts to cut the research activities by the House Appropriations Committee were soundly defeated. The budget was supported, with additional increases to provide for the education programs, by a high margin, which included most Republican and Democratic members of the House of Representatives. The overall NSF budget, as passed, has a total appropriation of $1103.5 million, compared with the Administration's request of $1033.5 million (the Fiscal Year 1981 appropriation for the NSF was $1022.4 million). The House approved budget included increases of $44.9 million in research and $25.1 million in science and engineering education. Included in the research budget increase were recommendations by the House Appropriations Committee for support of the social sciences and for the international affairs programs. Also included in the recommendations was support of interdisciplinary research programs that cut across the directorates of the NSF.

The House Appropriations bill provided increased support for the research budgets of the National Aeronautics and Space Administration (NASA). The Reagan administration has requested an overall research budget for NASA of $6122.2 million, an increase of $599.5 million over the Fiscal Year 1981 appropriation, mainly in the support of the space shuttle. The House raised the budget to $6133.9 million, with the largest increase going to research and development ($35 million increase over the OMB request), but there were budget reductions in research and program management ($14.3 million reduction from the OMB request) and in construction of facilities ($9 million reduction from the OMB request). The space shuttle program end related research will benefit, as will many others, such as the programs of technology utilization, energy technology, and space research and technology.

The budget of the Environmental Protection Agency (EPA) was also included in H.R. 4034. The EPA's budget was sharply reduced in the Reagan administration's request, and even though it was increased when the bill was introduced to the House floor, the total is still way down from last year's figure. The House approved a budget of $1201.5 million, compared with $1191.4 million in the Administration's request, and $1351 million for the Fiscal Year 1981 appropriation.

Whether the increased research budgets will survive the final compromises after action by the Senate remains to be seen. There is a groundswell of support in Congress for research at this time.—*PMB* ⊠

Forum

Planning for Giving

If your plan is for one year, plant rice;
For ten years, plant trees;
For a hundred years, educate people.

This ancient Chinese proverb stresses the importance of the role of AGU in the field of continuing education. When the Committee on Financial Resources made the recommendation that the Union should be on a firmer basis and the Council approved the 5-year fund drive, the vision was toward the future—decades at least—and far beyond 'rice' and 'trees.'

A large percentage of AGU members contribute regularly and liberally to their alma maters. This financial support to universities and colleges is essential. The donors are well rewarded with the knowledge that their gifts are to be used for education.

The same reward is available for the donor to the AGU Gift Fund to assure that the Union can continue to serve its members by publishing the results of research and by holding stimulating meetings. Once the motivation to give is reached, the form of giving becomes important. The tax laws and regulations enable the donor to plan a series of gifts over an extended period. That was one of the reasons for the council support of the 5-year plan. The use of a pledge card indicates the 'intention' of the donor and enables the steering committee to monitor the progress of the appeal.

We in geophysics have been fortunate and have prospered. The 'harvest has been good.' Whether it is the 'fat of the year' or the 'autumn of our lives,' let us make our plans for giving.

Charles A. Whitten

Bachelor's Degree Salary Report

An update on salary offers to graduating college seniors indicates sharp increases for those with bachelor's degrees in engineering and science, according to the College Placement Council.

Students majoring in petroleum engineering drew the top offers: $26,852 per annum, an 11.8% increase; some offers even topped $30,000 per year! Second-ranked chemical engineering, at $24,380, experienced a 12.7% gain. Since the July 1980 report, increases in average salary offers for the 11 bachelor's level engineering disciplines ranged from 10% to 14%.

On the other hand, students majoring in humanities and social sciences, who make up about 33% of the graduates at the bachelor's level, accounted for only 4% of the job offers reported in the survey, and their average beginning salary offers were only about half the top engineering average—$13,992 for other social sciences, $14,448 for humanities, and $16,440 for economics. Percentage increases for these disciplines ranged from 6.6 to 12.1.

The three business disciplines represented 22% of the bachelor's offers and reported increases of over 9% to 11% in average salary offers since a year ago. The highest average offer in this group, $17,018 went to accounting majors.

The seven scientific disciplines included in the survey accounted for 9% of the bachelor's volume. Computer science continued to dominate this category in number of offers, but commanded second place in terms of dollar value, with a reported annual average of $20,712, up 10.6%. The earth sciences and other physical sciences received the top dollar offer in this group. The annual average for this group was $22,152, which was 19.6% higher than the July 1980 figure.

At the master's level, chemical engineering recorded the highest average at $28,484 per year, up 13.4% since last year. MBA candidates with a technical undergraduate degree ranked second at $28,266 per year, an 11.1% gain.—*PMB*

Geophysicists

Robert E. Cyphers, Jr., 65, a Life Member of AGU, died on June 4, 1980. He joined AGU in 1941.

Eugene Leonardon, a Life Member, died on March 30, 1980. He joined AGU in 1933.

New Publications

The Geology of Europe

D.V. Ager, John Wiley, New York, xix + 535 pp., 1980, $44.95.

Reviewed by A. M. Celâl Şengör

For many years Derek Ager has been responsible for organizing and leading numerous delightful geological excursions in Europe; the reports of those undertaken under the aegis of the Geologists' Association have been published in the proceedings of the association, whereas countless other excursions live only in the memories and field-books of those who have participated in them. *The Geology of Europe* seems to be an outgrowth of its author's long-lasting love affair with his home continent (although he is an Islander!) and is one of the most entertaining regional geology books I have ever read. Much of it appears to have grown out of the field-trip reports that Ager wrote for the *Proceedings of the Geologists' Association*. The book is Europe as seen by a stratigrapher-paleontologist,' to quote its author. In one of the friendliest and most candid prefaces to any geological work, Ager makes it clear that what he narrates throughout the book is 'geology as it can be seen and as (he has) seen it (himself).' When I read through the book I was astonished to realize how much of it he has really seen. On the spot comparisons of outcrops with similar ones in other far-away places on the continent reveal a vast reserve of knowledge of the particulars of the geology of Europe.

Following a useful map of the geological divisions of Europe used in this book and an equally useful stratigraphic chart showing all that the author believes to be 'standard' stratigraphic divisions and their most commonly used alternatives from earthem to stage level, Ager discusses the general physiography, structure, and stabilization history of Europe mainly after Stillie's presentation in his immortal *Grundfragen der Vergleichenden Tektonik* (1924), and explains how the now-familiar tectonic divisions Eo-, Paleo-, Meso-, and Neo-Europa were defined. He writes that 'these refer to the age of the last major orogenic event affecting the rocks of the region concerned.' In Stillean terms (which still make a lot of sense) his meaning would have been much clearer had he written last major alpinotype orogenic event. As Stille himself often pointed out, the entire central European area had undergone major germanotype orogenies during the Mesozoic (in Teutoburgerwald Stille had in fact defined the first of his famous orogenic phases, that of the *jungkimmerischen*) yet it remains in Meso-Europa.

Corresponding with Stille's four-fold classification, the rest of the book is divided into four major parts, each devoted to one of the major divisions. In Eo-Europa, the Precambrian shields and Phanerozoic platform regions are discussed under three headings: the Fenno-Scandian Shield, the Hebridean Province, and the East European Platform. Under Paleo-Europa, Ager reviews the Caledonides and what he calls the 'Danish Triangle,' which includes the Baltic Plain, the North Sea Basin, and the Central British Block. Meso-Europa, part three of the book, includes the Hercynian chains of Europe plus the Urals. In part four, Neo-Europe, Ager follows very much the traditional Kober-Stille classification of the Alpides into northern Alpides and southern Alpides plus the intervening intra-Alpide massifs and basins, with a Staubian exception of the 'outer arcs.' Under this last category, the Pyrenees, the Ebro Basin, the Provence, the Jura and the Franco-Swiss Plain, Crimea, and the Greater Caucasus are assembled. The common denominator that characterizes all these objects is that they 'seem separate and distinct from the main continuous belt,' a statement only strictly true in a topographic sense. Ager's choice of presentation of Neo-Europa is unfortunate because it cuts through obvious palaeogeographic connections and confuses the reader. At the end of every part, he presents a synopsis and interpretation under the heading 'general conclusions.'

Although good humor permeates the text (statements, such as 'Pyrenees are almost too good to be true,' are not rare in the book), and although a lot of interesting cultural background information is given along with geology (along cultural lines I caught Ager once! It was his mistranslation of *Dikili Taş* (p. 268) as 'stones thrown from heaven'; it actually just means obelisk with no reference from where it may have come), I have found the geological information itself unsatisfactory in terms of content and, not rarely, out-of-date. Sketchy outcrop descriptions are indeed interesting, but they are often left 'hanging,' without having been woven into a coherent local and/or regional picture. Many of the geological sketch-maps and cross sections also suffer from old age (such as the cross section of the Massif Centrale after Lobeck). On the maps the lack of thrust symbols makes it impossible to see the relationships of units without having read the entire text, and even after that, in a few cases, questions remain in the uninitiated readers' mind. But the reader definitely gets the idea of the genuine complexities that battle the field geologist. Also, for an introductory book of this sort, synthetic stratigraphical tables showing major lithologies, unconformities, deformation episodes, etc. and correlation charts relating them to one another would have been of immense value to the beginner, and would have been expected of an author who himself is a stratigrapher. Not a single stratigraphic column is to be found in the entire book.

In general, *The Geology of Europe* is a useful introduction to European geology for traveling nonspecialists. I would recommend it to all who would like to buy one book on the geology of Europe (certainly way above the recent four-volume French compilation entitled *Geology of the European Countries*, even if there were no difference in price) with the reservation that they would get exactly what the author promises: the geology as it can be seen. The weakest parts of the book are the regional correlations and the tectonic interpretations. Ager's preferred interpretation of the plate distribution in the Mediterranean and their principal directions of relative movement (without time constraint, a naive concept in itself) is a good example of this weakness.

Owing to deficiencies of this and other kinds listed above, I find it difficult to recommend the book as a textbook for advanced courses in regional geology. Finally, the price of the hard-bound copy is a trifle too steep for the purposes for which this book was intended. A paperback version with a reduced price would have been much more suitable for many travelers and students.

A. M. Celâl Şengör, Department of Geological Sciences, State University of New York at Albany, Albany, New York.

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Prof. T. Tajima
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Geophysicist North Carolina State University—Raleigh. The Department of Marine, Earth and Atmospheric Sciences is reopening the search to fill a presently available tenure track position in geophysics. Rank is at the Assistant or Associate professor level. A Ph.D. is required.
Primary responsibilities will include generating and conducting research programs as well as teaching graduate courses in geophysics. The department currently consists of 31 regular faculty members including 18 in the areas of geology and geophysics. Please send resume and names of three references to J. L. Langfelder, Head, Department of Marine, Earth and Atmospheric Sciences, North Carolina State University, Raleigh, NC 27650. Deadline for receipt of applications is December 1, 1981.
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The University of Hawaii is an affirmative action and equal opportunity employer.

Research Positions/Seismology. Applications are invited for two possible research positions in the Institute for Geophysics, University of Texas at Austin, an equal opportunity employer.
Both positions involve field work on seismograph networks in Latin American countries, analysis and interpretation of data acquired from these networks and related seismological studies in the Caribbean and South America.
One Ph.D. level and one B.S./M.S. level positions are available. Salary for either position will be arranged depending on experience. Please send Resume and Bibliography to Toshimitu Matumoto, Institute for Geophysics, University of Texas at Austin, 700 The Strand, Galveston, Texas 77550.

One More Time

This was the view from Voyager 2 on July 12 as the spacecraft sped toward S[illegible] encounter with the planet's Saturn's rings brighter at [illegible] hemisphere sharper than similar photographs taken by Voyager 1. The bright [illegible] a higher sun angle. Voyager 2 was [illegible] million km from the ringed planet when this photo was taken. Watch for a full account [illegible] encounter in the September issue of EOS. Photo courtesy of NASA/JPL.

Assistant/Associate Professor
Mackay School of Mines
University of Nevada-Reno

The Department of Geological Sciences invites applications for the tenure track academic year position of assistant or associate professor of Geology to teach undergraduate and graduate courses (M.S. and Ph.D.) We are seeking an outstanding person with potential for teaching, establishing new laboratories and conducting and supervising research in the Basin and Range and adjoining Provinces. Publishable research will be expected. Areas of expertise within geology which will receive favorable consideration are structural geology, sedimentology, stratigraphy and carbonate petrology.

The position will be filled in either January or August 1982, depending on the availability of candidates. The Ph.D or equivalent degree is required. Salary and rank will depend on education and experience. Candidates should send a letter of application, list of publications, statement of teaching and research interests and transcripts and should arrange for at least three letters of reference to be sent to the Department. Closing date for application is November 15, 1981. Applications are to be sent to: Dr. L. C. Hsu, Chairman, Faculty Search Committee, Department of Geological Sciences, Mackay School of Mines, University of Nevada, Reno, NV 89557

University of Nevada is EOE/AAE

University of California, Santa Barbara/Assistant Professor of Geography. Tenure track position available July 1, 1982 Ph.D. required prior to appointment. Strong commitment to research and teaching and good background in computer and mathematical quantitative skills required. Major area of specialization should be cartography with other research and teaching interests in human geography. Submit resume, bibliography, and names of three referees to: Dr. Reginald D Golledge, Chairman, Department of Geography, University of California, Santa Barbara, CA 93106 Closing date: December 31, 1981.
Equal opportunity/affirmative action employer.

Faculty Positions/University of Petroleum & Minerals, Dhahran, Saudi Arabia. The Department of Earth Sciences will have faculty positions open for the academic year 1982–83, starting 1 September 1982 in the following areas
a Hydrogeology
b. Petroleum Geology
c Geochemistry
d Photogeology Geomorphology
e Geophysics
Minimum qualifications include Ph D degree plus field industrial teaching experience
Faculty will be involved in both teaching and research. Ability to teach geologic field courses is particularly desired Good research facilities are available and specialized equipment for approved research projects may be acquired. Current research includes saline deposits, sabkhahs regional structure, geotechnical properties of local soil and rock types. It also includes micropaleontological-microfacies analysis, stratigraphical analysis of both surface and subsurface sections, computerized bibliographies and geologic data banks, theoretical and applied studies of seismic surface waves, rock magnetism and paleomagnetism.
Language of instruction is English.
Minimum regular contract for two years, renewable Competitive salaries and allowances. Air conditioned and furnished housing provided Free air transportation to and from Dhahran each year. Attractive educational assistance grants for school-age dependent children All earned income without Saudi taxes. Ten months duty each year with two months vacation with salary. There is also possibility of selection for university's ongoing summer program with good additional compensation
Apply with complete resume on academic, professional and personal data, list of references, publications and research details, and with copies of degrees and or transcripts, including home and office addresses and telephone numbers to:
University of Petroleum & Minerals
Houston Offices
2223 West Loop South, Suite 410
Houston, Texas 77027.

Position in Reflection Seismology/Rice University, Houston, Texas. The Department of Geology plans to expand its geophysical program. Emphasis will be on reflection seismology. At this time applications are for the first of two open faculty positions The successful applicant will help in the search for and selection of the second faculty member.
Your main responsibility will be to lead our department into the area of modern reflection seismology. Your main teaching and research interests should be in the acquisition and processing of reflection seismic data. You should also help in developing rigorous undergraduate and graduate curricula, which are supported by the traditional strength of the Math Sciences, Physics, and Electrical Engineering Departments at Rice. Enthusiasm to work with and undertake some joint projects with our geologists is essential.
Our plans are to acquire a computer system configured for high quality data processing. Substantial seed money for this facility is already in hand. Creative cooperation with the oil and geophysical industry in Houston, including a reasonable amount of consulting, is encouraged. Salary will be commensurate with qualifications and experience.
Please send your curriculum vitae, a summary of experience in seismic processing, a statement of research interests, and names of three or more references to Dr. A. W. Bally, Chairman, Department of Geology, Rice University, P.O. Box 1892, Houston, Texas 77001. Application deadline—October 1, 1981.
Rice is an equal opportunity employer.

Atmospheric Scientist/Group Head. Senior staff scientist position available immediately at the NAIC's Arecibo Observatory. The successful applicant will be appointed as Head of the Atmospheric Sciences Group and will be expected to lead that group and to perform independent research using the Arecibo facilities. A Ph.D. degree in atmospheric or physical sciences or radar engineering and a record of solid research accomplishments are required Experience with radar studies of the stratosphere, mesosphere, and ionosphere or with HF modifications of the ionosphere is desirable. Salary open. Please send resume and names of at least three references to Dr. Harold D. Craft, Jr., Acting Director, NAIC Observatory, Space Sciences Building, Cornell University, Ithaca, New York 14853.
NAIC-Cornell University are EOE/AAE

Petroleum Geophysicist/New Zealand Geological Survey. New Zealand is undergoing major expansion of its energy resources investigations including prospecting for hydrocarbons. The Department of Scientific and Industrial Research, the principle Government R & D Agency, and advisor to government and industry in science and technology, has a vacancy in its Geological Survey for a seismic interpreter. The position, in the Petroleum and Basin Studies Section requires a person with a sound geological background primarily for regional analysis for the Basin Studies Programme.
Qualifications: A good 4 year bachelor's degree or higher, and at least 3 years petroleum exploration experience, are preferred.
Salary: A salary of up to NZ$23,520 per annum is offered for this position, depending on qualifications and experience.
Further information, application forms etc., may be obtained from the Ambassador Extraordinary and Plenipotentiary, New Zealand Embassy, Washington D.C. Applicants should quote Vacancy No. 2557 and forward applications, accompanied by a resume, to:
The Ambassador Extraordinary and Plenipotentiary
New Zealand Embassy
Observatory Circle, NW
Washington DC 20008
United States of America
Closing date for applications November 3, 1981.

City University of New York, (Brooklyn College)r Faculty Positions. The Department of Geology anticipates filling several tenure track positions at Full Professor level. (Salary range up to $43,400). Highly qualified individuals will be considered for distinguished appointments at an additional $5,000.
While candidates who have distinguished themselves in any field are welcome to contact us, we are particularly interested in openings in: energy resources (coal/petroleum), exploration geophysics, environmental geology or hydrogeology, coastal sedimentology, economic geology.
Successful applicants will be required to institute an active research program, supervise Master's and Ph.D. theses. Nominations and applications with current vitae should be sent to: Dr. S. Bhattacharji, Chairman, Dept. of Geology, Brooklyn College of City University of New York, Brooklyn, New York 11210. Positions open until filled.
Brooklyn College, CUNY, is an affirmative action/equal opportunity employer.

Senior Faculty Position/ Meteorology. Applications and nominations are invited for a senior faculty position in meteorology, at the University of Utah. Eligible applicant will also be considered for chairperson of the department. Candidates must possess a Ph.D. in meteorology or a related discipline. Applicants should have teaching and research experience and be interested in participating in both the graduate and undergraduate programs. Applicants should submit curriculum vitae and names of three professional references to:
Dr. Jan Peegle
Search Committee
Department of Meteorology
University of Utah
Salt Lake City, Utah 84112
Deadline for applications November 30, 1981.
The University of Utah is an affirmative action/equal opportunity employer.

California Space Institute, University of California, Santa Barbara/ Research positions in Remote Sensing. Basic and applied research in some combination of remote sensing of coastal zones, land use/land cover, natural and agricultural vegetation, and soil moisture with skills in information systems, automated image analysis, and quantitative modelling. We seek an independent worker with the goal of deepening and widening existing work in these areas on this campus. Ph.D. preferred. Rank and salary commensurate with experience. Closing date: November 30, 1981. Submit: resume; a brief account of research interests; and names of three professional referees to Dr. David S. Simonett, Department of Geography, University of California, Santa Barbara, California, 93106.
The University of California, Santa Barbara, is an equal opportunity/Affirmative Action employer.

HYDROGEOLOGISTS
Escape to Wisconsin

Residuals Management Technology is a consulting firm specializing in the waste management field. Headquartered in Madison, Wisconsin, we currently work in more than 20 states. If you are interested in waste management challenges facing the U.S. today—interested in locating minutes away from a major university—minutes away from great fishing and outdoor recreation, then let us get to know you. Our rapid growth has created openings in hydrogeology. Ideal candidates will have M.S. degree and 1-2 years experience in conducting hydrogeologic investigations and above average skills in verbal and written communications. Industrial experience a plus. Responsibilities include design of field investigation program, field work, data analysis, report writing, and work with industrial and public sector clients. Be a team member working with engineers, chemists, and other technical personnel on ground water pollution projects, design of solid and hazardous waste landfills, and mine waste feasibility and disposal plans. To be considered for these immediate openings, send a letter with salary history, professional and personal goals, and resume to Chief Hydrogeologist, David Nichols, Residuals Management Technology, 1406 E. Washington Avenue, Suite 124, Madison, Wisconsin 53703. AA/EOE.

Research Associate in Geochemistry/University of Chicago. Post-doctoral position involving extraction of micro-samples from meteorites under clean conditions and analysis for major and trace elements by instrumental and radiochemical neutron activation. Goal is to investigate behavior of the elements during condensation of the solar system.
Experience in geological samples an asset, in meteorites a definite plus and in radiochemistry a necessity. Send vita and names of two referees to Professor Lawrence Grossman, Department of Geophysical Sciences and Enrico Fermi Institute, University of Chicago, Chicago, Illinois 60637.
The University of Chicago is an affirmative action/equal opportunity employer.

SERVICES

Coal Deposits. If you are financing, planning, exploring, drilling, or digging in connection with any form of energy, you need this complete, up-to-date book about the world's coal deposits Includes production and reserves for mines. Hardcover, 8 x 9 inches, 500 pages. Table of contents, drawings, index, references, 1980. $156. Tetech Associates, Thunder Road, Sudbury, MA 01776, USA.

COURSES

MSA Amphiboles Short Course. The Mineralogical Society of America will sponsor a Short Course on Amphiboles and Other Hydrous Pyriboles at the Marydale Retreat Center in Erlanger, Kentucky, October 29 to November 1, 1981, before the MSA/GSA Annual Meeting in Cincinnati, Ohio.
Instructional Staff will be:
J. B. Thompson, Jr. (Harvard)—Polysomatism and polytypism in pyriboles
F. C. Hawthorne (Manitoba)—Crystal chemistry of amphiboles
S. Ghose (Univ. Washington)—Subsolidus reactions of amphiboles
P. Robinson (Univ. Massachusetts)—Amphiboles of metamorphic rocks
M. C. Gilbert (VPI)—Phase equilibria and amphiboles of igneous rocks
D. R. Veblen (Johns Hopkins) (Convenor and Editor)—Wide-chain pyriboles
T. Zoltai (Univ. Minnesota)—Mineralogy of amphibole asbestos
M. Rose (USGS)—Geological occurrence of amphibole asbestos
Contact: MSA, 2000 Florida Avenue, N.W., Washington, D.C. 20009. Telephone: 202/462-6613.
Registration Deadline: October 1, 1981.

STUDENT OPPORTUNITIES

Research-Cum-Teaching Assistance Ships. Available in Space Physics and Atmospheric Science Programs. Stipend during academic year is $777 per month and twice this rate during summer. Write to: G. G. Sivjee, Head Space Physics and Atmospheric Science Program, Geophysical Institute, University of Alaska, Fairbanks, AK 99701 or call (907) 479-7058.

Graduate Research Assistantships in Civil Engineering. The Department of Civil Engineering at Princeton University invites applications for graduate study and research in the areas of structures and mechanics, transportation, water resources and engineering management systems leading to M.S.E. and Ph.D. degrees. Including tuition, annual research stipends range from $14,000 to $15,000 and are offered to all admitted students requesting support. For details and application write: Ahmet S. Cakmak, Director of Graduate Studies, Department of Civil Engineering, Princeton University, Princeton, NJ 08544.

Graduate Study in Space Physics and Astronomy. Rice University is pleased to offer Fellowships for entering graduate students in the Department of Space Physics and Astronomy. Exciting research is underway in the fields of theoretical and experimental space plasma physics, magnetospheres of the earth and planets, atmospheric and ionospheric physics, laboratory studies of Rydberg atoms, laser research, space solar power studies, and astronomy and astrophysics.
The fellowships for first year students presently are $4845 taxfree for 9 months, plus tuition, and involve only 4–5 hours tutoring, grading, or instructing per week for four semesters. Research assistantships for summers and subsequent years are generally available at $550 per month. Students with exceptional undergraduate records and GRE scores are eligible for an additional $1000 Presidential Recognition Award. Raises are expected for next year.
Address inquiries to: Dr. Patricia Reiff, Assistant Chairman, Department of Space Physics and Astronomy, Rice University, 77001.

AGU

Nominations for Officers 1982–1984

The following nominees were presented by the Union and section nominating committees and were accepted by the Council:

Union

President-elect
Charles L. Drake
M. Gordon Wolman

Sections

President-elect	*Secretary*
Geodesy	
Byron D. Tapley	John D. Bossler
Petr Vaníček	Robert F. Brammer
Geomagnetism-Paleomagnetism	
Christopher G. A. Harrison	Ronald T. Merrill
Neil D. Opdyke	Maureen B. Steiner
Hydrology	
R. Allan Freeze	Thomas Maddock III
Donald R. Nielson	Eric F. Wood

President-elect	*Secretary*
Meteorology	
W. Lawrence Gates	Ronald L. Lavole
Fred D. White	Ronald C. Taylor
Oceanography	
Donald V. Hansen	Peter G. Brewer
Joseph L. Reid	J. Dungan Smith
Planetology	
Laurence A. Soderblom	Thomas B. McCord
David W. Strangway	Joseph F. Veverka
Seismology	
Michael A. Chinnery	Thomas H. Jordan
Lynn R. Sykes	Robert B. Smith
Solar-Planetary Relationships	
George C. Reid	
Christopher T. Russell	
Aeronomy	
	J. R. Doupnik
	Raymond G. Roble

President-elect	*Secretary*
Cosmic Rays	
	Shakil P. Duggal
	Miriam A. Forman
Magnetospheric Physics	
	Theodore A. Fritz
	Michael Schulz
Solar & Interplanetary Physics	
	Leonard F. Burlaga
	Bruce T. Tsurutani
Tectonophysics	
Thomas J. Ahrens	Christopher Scholz
Johannes Weertman	Joseph B. Walsh
Volcanology, Geochemistry, and Petrology	
G. Brent Dalrymple	J. Lawford Anderson
Heinrich D. Holland	Peter W. Lipman

Members of AGU are invited to submit additional nominees by petition in accordance with the bylaws. Each petition must be signed by at least 1% of the voting members of the Union or section, as the case may be, and such petitions must be received by the General Secretary by November 30, 1981. The number of names required to make a petition nomination is as follows: Union, 131; Geodesy, 8; Geomagnetism and Paleomagnetism, 7; Hydrology, 23; Meteorology, 10; Oceanography, 18; Planetology, 8; Seismology, 13; Solar-Planetary Relationships, 15; Tectonophysics, 11; and Volcanology, Geochemistry, and Petrology, 12.

Union: President-Elect

Charles L. Drake. A member of AGU since 1950; 58 years old, Dean of graduate studies, associate dean of sciences division, professor of earth sciences, Dartmouth College. Major interests: solid earth geophysics and tectonics. B.S.E. in geological engineering, Princeton, 1948; Ph.D. in geology, Columbia, 1958. Columbia faculty until 1969, at that time professor and chairman; Department of Geology, Dartmouth College since 1969. Fellow: AGU, GSA, AAAS, RAS; member: AAPG, SEXG, SSA, Sigma Xi, MTS, AGID. Has been president GSA, on council of AAAS, on research committee of AAPG, on governing board of AGI. Served on many committees, chaired Office of Earth Sciences, U.S. Geodynamics Committee, Committee Advisory to ESSA (NOAA), Panel on Gas Reserve Estimates, U.S. National Committee on Geology, Geophysics Study Committee, etc of NAS-NRC. Past president, International Commission on Geodynamics, ICSU; 75 publications, 14 printed by AGU. Distinguished Lecturer: AAAS, AAPG; Honorary Member, Geological Society of France. Served as member of AGU Committee on International Participation; coeditor AGU Monograph 12; editor, *Geodynamics: Progress and Prospects.*

M. Gordon Wolman. Age 56 and a member of the American Geophysical Union since 1954. He is a professor of geography and chairman of the Department of Geography and Environmental Engineering of The Johns Hopkins University. His areas of scientific interest are geomorphology, in particular, alluvial morphology, hydrology, sedimentation, water quality, and the relationship of natural surficial processes to alterations of the environment by men. He received his B.A. (1949) from The Johns Hopkins University, M.S. (1951), and Ph.D. (1953) in geology from Harvard University. From 1953 to 1956, Wolman worked with the Water Resources Division of the U.S. Geological Survey. Appointed in 1956 to Johns Hopkins, his research includes studies of urban river systems, energy and environment, and environmental quality policy. He was a councilor of the Geological Society of America (1979–79) and American Geographical Society (1966–70), and member of the Executive Committee, Division of Earth Sciences (1966–69), Executive Board, University Council on Water Resources, 1963, National Academy of Sciences Committee on Water (1965–68), IHS Environmental Studies Board (1974–77), and chairman of the NAS-NAE Committee on Water Quality Policy (1974–79). He is currently president of the Board of Resources for the Future and was recently elected a fellow of the American Academy of Arts and Sciences. He has authored or coauthored approximately 50 scientific publications, including a text: Leopold, Wolman, and Miller, *Fluvial Processes in Geomorphology.* Wolman was chairman of the AGU Subcommittee on Sedimentation (1960–62), member of the Committee on Status and Needs in Hydrology (1964), president of the Section on Hydrology (1970–72), and delegate to the IGU meeting in Moscow in 1972. He currently serves on the Membership Committee.

Geodesy: President-Elect

Byron D. Tapley. Age 48, joined AGU in 1970. Tapley currently serves as the W. R. Woolrich Professor, Department of Aerospace Engineering and Engineering Mechanics, and as the director of the Institute for Advanced Study in Orbital Mechanics at The University of Texas at Austin. His research interests include satellite applications to geodesy, geodynamics, oceanography, and nonlinear parameter estimate theory. Currently he is involved in the analysis of satellite altimeter data and in the application of laser ranging to polar motion determination and precise point positioning as a part of NASA's Crustal Dynamics Program. He received a B.S. (1966) in M.E. and an M.S. (1966) and Ph.D. (1969) in engineering mechanics from The University of Texas at Austin. He joined the U.T. aerospace engineering faculty in 1969. He served as chairman of the combined ASE-EM Department from 1986–1977. He is a current member of the AGU Gifting for Tomorrow (GIFT) Committee. In addition to the AGU, his society memberships include AIAA, AAAS, AAU, IEEE, IUGG, IAG (Commissions 17 and 19), and COSPAR (Working Group 1). He is a fellow of AIAA and AAAS. He served as chairman (1973) and committeeman-at-large (1974–1979) for Section M (Engineering), AAAS; and chairman (1973–1975), AIAA Technical Committee on Astrodynamics. He currently serves as committeeman, Division of Dynamical Astronomy, American Astronomical Society. He served as chairman, Region IV, ECPD Engineering Education and Accreditation Committee from 1973 to 1975. He is the current chairman of the National Research Council, Geodesy Committee. He is an associate editor of AGU's *Geophysical Research Letters*, the *Celestial Mechanics Journal*, and the AIAA *Journal of Guidance and Control.* He has authored over 70 articles in refereed journals and over 70 chapters, reports, or sections in conference proceedings and edited three conference proceedings. Tapley is a member of the NASA Ocean Topography Experiment (TOPEX) Science Working Group and the GRAVSAT User's Working Group.

Petr Vaníček. Member since 1970; age 45. Professor of geodesy, University of Toronto (Erindale College) and University of New Brunswick, Fredericton. Current research interests: geodynamics, earth gravity field, mathematical techniques of geodesy, application of statistics in geodesy, applications of extraterrestrial methods to geodesy, physical oceanography, theoretical elasticity. Received dipl. ing. degree in geodesy (1959) in Czech Technical University in Prague and Ph.D. in mathematical physics (1968) in Czechoslovak Academy of Sciences in Prague. Worked as a surveyor at Prague Institute of Surveying and Cartography (1959–1963), consultant in numerical analysis and computer applications at Faculty of Technical and Nuclear Physics of Czech Technical University (1963–1967), research fellow and later senior scientific officer at Institute of Oceanography, Bidston, U.K. (1967–1969), NRC of Canada postdoctorate fellow in Surveys and Mapping Branch of EMR, Ottawa (1969–1971), associate and full professor of geodesy at UNB (1971–1991), visiting scientist, USGS Center for Earthquake Research, Menlo Park, California (1977). Member of executive CGU, fellow of GAC, Sigma Xi, member of CIS, NYAS, SVU, member of Canadian National Committee for IUGG. Author of 110 books and papers, including three papers in *Eos* (e.g., 'The Map of Contemporary Vertical Crustal Movements in Canada,' coauthor D. Nagy) and one in *Reviews of Geophysics and Space Physics* ('Geodetic leveling and its applications,' coauthored by R. O. Castle and E. I. Balaze). Coeditor of *Manuscripta Geodaetica.* Member of IAG working groups 1:21, 1:41, 4:90, 5:83, Canadian representative on IUGG Commission on Recent Crustal Movements. Honours include: NERC (U.K.) Senior Research Fellowship (1967–1969), NRC (Canada) Postdoctorate Fellowship (1969–1971), CNPq (Brazil) Visiting Professorships (summers 1975, 79, 79), NRC (U.S.A.) Senior Visiting Scientist (1976), University of Stuttgart (W. Germany) Visiting Professorship (summer 1991), University of São Paulo (Brazil) Visiting Professorship (summer 1991). Since 1979 has served on AGU GMP Committee.

Geodesy: Secretary

John D. Bossler. Age 44, joined the American Geophysical Union in 1972 and is currently employed with the Department of Commerce, NOAA, Rockville, Md. His scientific interests are in geophysics and geodetic science, with degrees from the University of Pittsburgh, B.S. (1959) and Ohio State University, M.S. (1964), Ph.D. (1972). Professional experience: chief, astronomic geodetic field parties and other mobile field party units, where he received training in all phases of geodetic operations; candidate for two full-time university training assignments at OSU, developed mathematical formulas and computer programs to support Worldwide Satellite Triangulation Network of NOAA, Rockville, Md., served as project manager for the readjustment of the North American Datum, served concurrently as project manager and deputy director, National Geodetic Survey, Department of Commerce, NOAA, Rockville, Md. He is secretary, Geodesy Section, AGU; vice chairman, ASCE, Surveying and Mapping Division; member, IUGG, IAG, Special Study Group 5.39; president, Subcommission for North America of Commission X, IAG; secretary of Section I of the IAG; member, Board of Direction, ACSM; and associate editor, JGR, AGU. He has authored 30 publications. Some examples are: 'Optimal Design of Geodetic Nets,' *Journal of Geophysical Research*, 'Man's Geophysical Environment—Its Study from Space,' a report to the administrator of ESSA. Honors: National Honorary Engineers Fraternity, Sigma Tau; two Helekanen Awards from OSU for eminence in the field of geodetic science, and several letters of commendation for accomplishments in his field of expertise.

Robert F. Brammer. AGU member, 1977. Born in Washington, D.C., 1949. Currently, director of the Physical Sciences Division at TASC, managing 50 professionals and several programs in geodesy, geomagnetism, oceanography, and hydrologic forecasting. His geodesy work includes principal investigator studies for both the GEOS-3 and SEASAT altimeters (high-resolution geoids and seamount detection), the design and development of a new computer system for the DoD Gravity Library, and analysis of gravity effects on satellite and strategic systems. Other scientific interests include satellite oceanography and geomagnetism. He is a principal investigator for MAGSAT, developing signal processing methods for magnetic anomaly mapping and for tectonic interpretation, using both MAGSAT and satellite altimeter data. Brammer received a B.S. from the University of Michigan in 1969 and an M.A. and Ph.D. from the University of Maryland in 1970 and 1972, respectively. Before joining TASC, he was with NASA/GSFC working on Apollo and Skylab. He is also a member of the SEG, the AMS, SIAM, and the IEEE. He has published more than a dozen technical papers, including GEOS-3 results in JGR and SEASAT results in *Geophysics Research Letters*. He is a member of Phi Beta Kappa, Phi Kappa Phi, a Woodrow Wilson Fellow, and a recipient of the National Science Foundation grants for research in mathematics. Currently, he is serving as chairman of the External Liaison Committee for the Geodesy Section of the AGU, arranging for joint conference sessions with other professional societies.

Geomagnetism and Paleomagnetism: President-Elect

Christopher G. A. Harrison. Born in Oxford, England, in 1938; he has been a member of AGU since 1965. He is presently professor and chairman of the Division of Marine Geology and Geophysics of the School of Marine and Atmospheric Science, University of Miami, where he has been since 1967. His research interests include paleomagnetism and its application to the study of plate motions and paleoclimatology and secular variation of the earth's magnetic field (JGR *85*, p. 3511). He is also interested in marine magnetic anomalies and their sources (JGR *75*, p. 2033) and is currently investigating long-wavelength magnetic anomalies recorded by MAGSAT. He has also studied reversals of the earth's magnetic field (*Nature, 204*, p. 566). He obtained a B.A. from Cambridge University in 1960, majoring in physics, and a Ph.D. from the Department of Geodesy and Geophysics in the same university in 1964. From 1961 to 1967 he was a postgraduate research geophysicist at the Scripps Institution of Oceanography, University of California. He is a member of AAAS and a fellow of the Royal Astronomical Society. He was recently a member of the Publications Study Committee for the Geological Society of America. He has authored or coauthored over 70 papers, of which about a quarter have been published in AGU journals, and he has been author or coauthor of more than 30 papers presented at AGU meetings. Harrison was an associate editor of JGR from 1973 to 1976 and was geomagnetism and paleomagnetism member on the Spring Meeting Program Committee for 1977 and 1978. He was chairman of the AGU Publications Committee from 1978 to 1980. He is currently chairman of the AGU Budget and Finance Committee.

Neil D. Opdyke. Age 49; joined the American Geophysical Union in 1959. He is presently chairman of the Department of Geology, The University of Florida, Gainesville, Florida. Opdyke's research interests have been in paleomagnetism and its application to tectonic and stratigraphic problems. He has also been interested in paleoclimatology. He received his B.A. degree from Columbia College in 1955 and his Ph.D. in 1958 from Durham University, U.K. He held postdoctoral fellowships at Rice University in 1958–59, The Australian National University in 1960–61, The University of Rhodesia and Nyasaland in 1961–63. He has been a member of the staff at Lamont-Doherty Geological Observatory from 1964 to 1981, where he served successively as research associate, adjunct professor, and interim director. Opdyke is a fellow of the American Association for the Advancement of Science and the Geological Society of America, where he served as chairman of the Geophysics Section in 1979–80. He is the author or coauthor of 100 scientific papers. He became a fellow of the American Geophysical Union in 1976 and served on the Committee of Fellows and as chairman of the Bowie Awards Committee. He also served as program chairman for the GP section in 1979–80 and as associate editor for the AGU Bulletin in 1979–80.

Geomagnetism and Paleomagnetism: Secretary

Ronald T. Merrill. Age 43, a member of AGU since 1964. He received his B.S. and M.S. degrees in mathematics from the University of Michigan in 1959 and 1961, respectively. He received his Ph.D degree in geophysics from the University of California at Berkeley in 1967. Merrill is currently a professor in geophysics and oceanography at the University of Washington in Seattle. He has also held visiting faculty appointments at the Research School of Earth Sciences at the Australian National University in 1974, 1976, and 1979. In 1992 he will become a professor of geophysics and geological sciences at the University of Washington, and he will spend a few months as a visiting faculty member at the Australian National University. He was associate editor of the red JGR from 1978 to 1981. In addition, he has also been an associate editor for the *Quaternary Research Journal* and a guest associate editor for the *Physics of Earth and Planetary Interiors*. Merrill has served on the Lunar Science Review Panel and the Lunar and Planetary Science Review Panel. He has authored or coauthored over 30 scientific articles, mostly in geomagnetism, including nine articles in JGR and three in the *Reviews of Geophysics and Space Physics*. Merrill's current research is primarily in rock magnetism and paleomagnetism. He is also working on a book, to be coauthored with M. W. McElhinny, on the history and origin of the earth's magnetic field.

Maureen B. Steiner. Age 36; a member of AGU since 1970. She is employed as a research scientist in the University of Wyoming Department of Geology and Geophysics. Her areas of interest include geomagnetic field reversal history and mechanisms, plate motions, origins of sedimentary remanent magnetization, mineralogy of iron oxides and the effects of magnetization on oceanic basalt magnetization. She holds a B.S. (1966) and M.S. (1967) from Southern Methodist University and a Ph.D. (1974) from the University of Texas at Dallas. Steiner has been employed in several research science

positions since 1974, primarily at California Institute of Technology and at the University of Wyoming. Her recent work has centered around the definition of reversal patterns in the Mesozoic and use of these for correlation purposes and the investigation of the source and characteristics of magnetization in the ocean floor. She has authored or coauthored 24 scientific publications and has presented 19 papers at national meetings. Among other contributions, this work has produced an apparent polar wander path for North America during the Jurassic and has demonstrated that a long period of constant geomagnetic field polarity did not characterize that time. Steiner is currently serving as AGU Fall Program chairman for geomagnetism.

Hydrology: President-Elect

R. Allan Freeze. Age 42; a member of the Hydrology Section of AGU since 1970. He is currently a professor in the Department of Geological Sciences and an associate dean in the Faculty of Graduate Studies at the University of British Columbia in Vancouver, Canada. He obtained his B.Sc. in geological engineering from Queens University in 1961 and his Ph.D. in civil engineering from the University of California at Berkeley in 1966. Before joining UBC, he was a research scientist with the Hydrologic Sciences Division of the Canada Inland Waters Branch in Calgary, Alberta, and a research staff member at the IBM Thomas J. Watson Research Center in Yorktown Heights, N.Y. He is the author of over 50 technical publications in the fields of hydrology, hydrogeology, soil physics, and engineering seepage. He is coauthor (with J. A. Cherry) of the textbook, *Groundwater*, published in 1979. In addition to AGU, he is a member of the Geological Society of America, the Canadian Geotechnical Society, and the Association of Professional Engineers of British Columbia. Freeze was awarded the Horton Award by AGU in 1970 (with J. A. Benner) and in 1972 for his papers in *Water Resources Research* on 'The Mechanism of Natural Groundwater Recharge and Discharge' and 'The Role of Subsurface Flow in Generating Surface Runoff.' The latter paper also resulted in the 1974 Meinzer Award from the Geological Society of America. Freeze received the Macelwane Award from AGU in 1972. He served as editor of *Water Resources Research* during the period 1976–1980.

Donald R. Nielsen. Age 49; a member of AGU since 1958. He is professor of soil and water science in the Department of Land, Air, and Water Resources, University of California, Davis. His areas of scientific interest include hydrology, water and solute behavior in the vadose zone, and soil physics. He holds B.S. (1953) and M.S. (1954) degrees from the University of Arizona and the Ph.D. (1958) from Iowa State University. Nielsen has been employed by the University of California since 1958 and has served as associate dean, director of the Kearney Foundation, and chair of Land, Air and Water Resources. He has served as a consultant for the U.S. Army, NASA, State of California Department of Water Resources, USEPA, FAO/IAEA, USAID, and USDA. He is president of the Soil Physics Commission of the International Soil Science Society, associate editor of the *British Journal of Soil Science*, and has served on boards of directors of the Soil Science Society of America and American Society of Agronomy. Presently, he is on the Panel of Remote Sensing for Water Resources of the Space Applications Board of NRC and has served on panels of the Geophysics Board and on Water Resources Review Committee of the Food and Agriculture Board of the National Academy of Science. He has authored or coauthored more than 150 scientific articles and edited three books. He is a fellow of the Soil Science Society of America and of the American Society of Agronomy. He is also a member of Sigma Xi, Phi Kappa Phi, Gamma Sigma Delta, Phi Lambda Upsilon, and Pi Mu Epsilon. He has been a senior postdoctoral fellow of NSF and an invitational symposium speaker in more than 15 countries. Nielsen has served on Soil Moisture Program committees of AGU, and since 1970, has served as associate editor of *Water Resources Research*.

Hydrology: Secretary

Thomas Maddock III. Age 42; a member of AGU since 1968. He is currently professor of hydrology and water resources at the University of Arizona and specializes in groundwater management. Maddock received an undergraduate degree from the University of Houston and his masters and Ph.D. degrees from Harvard under the Harvard Water Program. Before leaving to join academia, he worked for the U.S. Geological Survey as a member of its Water Resources Division System Analysis Group and Groundwater Branch. Maddock was an associate editor for Water Resources Research and was chairman of the AGU Hydrology Division Committee on Water Resource Systems. A member of AWRA; Sigma Pi Sigma, an honorary physics society; and of the ASCE Committee for the Inverse Problem, he is currently an editor of the AGU Monograph Series.

Eric F. Wood. Age 33; a member of AGU since 1971. He is an assistant professor of civil engineering and director of the Water Resources Program at Princeton University. His areas of scientific interest include stochastic hydrology, forecasting, and water resources planning and optimization. He holds a B.A.Sc. (honors; 1970) from the University of British Columbia, and S.M. (1972), C.E. (1973), and Sc.D. (1974) from the Massachusetts Institute of Technology. Wood has been at Princeton since 1976. From 1974–1978 he was a research scholar at the International Institute for Applied Systems Analysis (IIASA) in Laxenburg, Austria. He participated in the National Science Foundation working group on flood hazard mitigation. Wood has authored or coauthored more than 35 scientific articles and publications and has edited one book entitled *Real-Time Forecasting/Control of Water Resource Systems* (Pergamon, 1980). He was awarded the Horton Award for his paper 'An Analysis of the Effects of Parameter Uncertainty in Deterministic Hydrologic Models' (*WRR, 12*(5), 925–932). He has served on the AGU Data Network Design Committee since 1977, has been an associate editor of *Water Resources Research* from 1977, and is on the editorial board of the AGU Water Resources Monograph Series.

Meteorology: President-Elect

W. Lawrence Gates. Age 52, a member of AGU since 1959. He is presently professor and chairman of the Department of Atmospheric Sciences at Oregon State University and also founder and director of the OSU Climatic Research Institute. His areas of current scientific interest are climate dynamics, paleoclimatology, the general circulation, and atmospheric modeling. He holds the degrees of S.B. (1950), S.M. (1951), and Sc.D. (1955), all from the Massachusetts Institute of Technology. Gates has been employed by the Air Force Cambridge Research Laboratory (1953–57), where he directed the numerical weather prediction project; the Department of Meteorology at UCLA (1957–68), where he was assistant and then associate professor; and the Rand Corporation (1966–79), where he directed the climate program. He has been at OSU since 1978. Gates has been a member of numerous committees and panels of the American Meteorological Society, the Environmental Protection Agency, the National Aeronautics and Space Administration, the National Academy of Sciences, the University Corporation for Atmospheric Research, and the World Meteorological Organization; his present activities include membership in the Working Group on Numerical Experimentation of the WMO's World Climate Research Program and the Climate Research Committee of the National Academy of Sciences' Climate Research Board. He has authored or coauthored approximately 40 published articles of which five are in AGU journals, and he has written more than 45 other technical reports. In 1980, he was elected a fellow of the American Meteorological Society, and in 1981 he became a fellow of the American Association for the Advancement of Science.

Fred D. White. Age 93 and a member of AGU since 1960. He was elected a fellow of AGU in 1967. He is currently employed as executive secretary of the National Research Council's Committee on Atmospheric Sciences and by the American Meteorological Society as editor of its *AMS NEWSLETTER*. He holds an A.B. (1941) from Miami University and a Ph.D. (1963) from the University of Wisconsin. White served with the U.S. Air Force from 1941–1963 and is a colonel in the USAF Reserve. He worked with the U.S. Weather Bureau from 1948–1958 and with the National Science Foundation from 1958–1976. He is a member of Sigma Xi; American Meteorological Society (has served on the Council, chairman of the nominating committee, and chairman of the Washington Chapter); and AAAS (has served as chairman of the Atmospheric and Hydrospheric Sciences Section and on the nominating committee). White served on AGU Statutes and By-Laws Committee from 1964–1972.

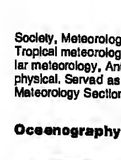
Meteorology: Secretary

Ronald L. Lavoie. Age 49; became a member of the AGU in 1992. He is director of the Atmospheric Programs Office in the National Oceanic and Atmospheric Administration's Office of Research and Development. His main areas of scientific interest are numerical modeling on the mesoscale, cloud physics, and weather modification. He received a B.A. (1954) from the University of New Hampshire, an M.S. (1959) from Florida State University, and the Ph.D. (1969) from the Pennsylvania State University. Lavoie began his career as meteorologist-in-charge of the Mt. Washington Observatory in New Hampshire (1957–59). He served on the faculty of the meteorology department at the University of Hawaii, where he was also a member of the Hawaii Institute of Geophysics, from 1959 to 1968. He was an associate professor at Pennsylvania State University from 1968 to 1973, including a year on Intergovernmental Personnel Act assignment to the National Science Foundation as associate program manager for meteorology. He has been with NOAA since 1973. Lavoie is a fellow of the American Meteorological Society, which he has served as chairman of the Committees on Cloud Physics, Awards, and Weather Modification. He is also a fellow of the AAAS and a member of the Weather Modification Association, Sigma Xi, and Phi Beta Kappa. He serves on advisory committees to the National Center for Atmospheric Research and the World Meteorological Organization. He has authored or coauthored 16 articles in journals or books and has been on program committees for several national and international conferences.

Ronald C. Taylor. Age 48; member of AGU since 1955. National Science Foundation, Atmospheric Research Section/Meteorology Program, Washington, D.C. Born, Port Huron, Michigan, 1932. B.A., 1959, University of California, Los Angeles; Ph.D., 1968, University of Hawaii. Assistant professor of meteorology, Saint Louis University, 1968–1969, University of Hawaii, 1969; research contract, U.S. Navy Weather Research Facility, Norfolk, Virginia, 1969; graduate program in meteorology, University of Maryland, 1975. Member, AAAS, American Meteorological Society, Meteorological Society of Japan. Tropical meteorology air-sea interaction; polar meteorology, Antarctic, synoptic, and physical. Served as secretary of the AGU Meteorology Section 1979–1980.

Oceanography: President-Elect

Donald V. Hansen. Age 50 and a member of AGU since 1963. He holds degrees in physics (B.S., 1954) and oceanography (M.S., 1961; Ph.D. 1964) from the University of Washington, Seattle. He served on active duty in USAR as meteorological officer and artillery officer during 1954–56. He subsequently worked as an engineer in testing and evaluation for Boeing Airplane Company and as a science teacher with the Seattle public schools. Following his graduate education he held a position as research assistant professor at the University of Washington before accepting a position as research oceanographer with the U.S. Department of Commerce. He has been director of the Physical Oceanography Laboratory, Atlantic Oceanographic and Meteorological Laboratories (AOML) since 1969, and additionally was acting director, AOML, during 1978–80. He is a member also of Sigma Xi, ASLO, AAAS, Florida Academy of Science, and International Oceanographic Foundation and holds an adjunct faculty appointment at the University of Miami. Hansen has over 40 publications in oceanography, two of which appeared in AGU journals, and has made numerous presentations at and chaired scientific sessions at the AGU meetings. He has received NOAA awards for distinguished scientific authorship in 1971, 1975, 1977, and 1980. He has also received other NOAA awards. He served as associate editor, *Journal of Geophysical Research*, during 1966–68, and is presently a member of the AGU Committee on Coastal and Estuarine Regimes.



Joseph L. Reid. Age 58; B.A., University of Texas (1942), M.S., Scripps (1951); a member of AGU since 1950 and a fellow since 1975. Professor of physical oceanography at the Scripps Institution of Oceanography, where he has worked since 1951. He served as president of the Oceanography Section of AGU 1972–1974 and on the Fellows Committee 1979–1980. He has authored or coauthored over 60 articles in the refereed journals (13 in AGU publications), and he has served as associate editor to several journals, edited several books, and contributed several reviews. His area of interest is the circulation of the world ocean, the characteristics of the waters and the areas and manner of their formation. He has carried out several oceanographic expeditions in the Pacific, Antarctic, and Atlantic oceans, including a study of the Northwestern Pacific, Bering and Okhotsk seas in January–March 1999. In 1955 he proposed and coordinated the NORPAC Expedition, a program for collecting oceanographic observations over the entire North Pacific north of 20°N and carried out by 19 ships of the United States, Japan, and Canada. He is one of the originators of the GEOSECS expeditions. He has served on various advisory panels to N.S.F. and other federal agencies, and S.C.O.R. He is a member of A.S.L.O. and A.A.A.S. Representative publication: 1981, On the Mid-Depth Circulation of the World Ocean, Chapter 3, in *Evolution of Physical Oceanography* (B. A. Warren and C. Wunsch, editors), The MIT Press, pp. 70–111.

Oceanography: Secretary

Peter George Brewer. A senior scientist in the Chemical Oceanography Department at the Woods Hole Oceanographic Institution, he has been a member of the American Geophysical Union since 1979. Born in December 1940, he earned both his undergraduate and graduate degrees at Liverpool University, England, in 1962 and 1967, respectively. He came to WHOI as an assistant scientist in 1967, was appointed an associate scientist in 1971, and a senior scientist in 1978. His professional activities include memberships in the American Chemical Society, the Geochemical Society, the American Association for the Advancement of Science, and the American Geophysical Union.

His scientific interests include the analytical chemistry of seawater, trace element geochemistry, the chemistry of marine particulate matter, the physical properties of seawater, and the oceanic carbon dioxide system. Among his 48 publications and nine technical reports are the following: Brewer, P. G., and A. Bradshaw, 1975, The effect of non-ideal composition of seawater on salinity and density, *J. Mar. Res., 33*, 157–175; Brewer, P. G., 1978, Direct observation of the oceanic CO_2 increase, *Geophys. Res. Lett., 5*, 997–1000; Brewer, P. G., Y. Nozaki, D.W. Spencer, and A. P. Fleer, 1980, Sediment trap experiments in the deep North Atlantic: isotopic and elemental fluxes, *J. Mar. Res., 38*(4), 703–726; Ballistrat, L., P. G. Brewer, and J. W. Murray, 1980, Scavenging residence times of trace metals and surface chemistry of sinking particles in the deep ocean, *Deep-Sea Res.*, submitted.

J. Dungan Smith. Age 42; professor and chairman of the Geophysics Program at the University of Washington, also professor in the Department of Oceanography and Geological Sciences; joined AGU in 1965. Scientific interests: estuarine and coastal physical oceanography, turbulent boundary layer mechanics, physics of marine and fluvial sediment transport. B.A. and M.S. in geology from Brown University, 1962, 1963; Ph.D. in geophysical fluid mechanics from University of Chicago, 1969. Employed at University of Washington 1967–present. Member of AGU, AAAS, Sigma Xi, IAHR. Twenty-two scientific papers, e.g., (1) Modeling of sediment transport on continental shelves, (2) Measurements of the turbulent boundary layer under pack ice, (3) Time-dependent mixing in a salt wedge estuary, and (4) Tidal interaction of stratified flow with a sill in Knight Inlet. Four papers in JGR, e.g., (1) Stability of a sand bed subjected to a shear flow of low Froude number, (2) Spatially averaged flow over a wavy surface, and (3) Turbulence measurements in the boundary layer over a sand wave field. Recent honors: Senior Queen's Fellowship in Marine Sciences (Australia); Service in AGU: past associate editor of JGR.

Planetology: President-Elect

Laurence A. Soderblom. Currently chief of the Branch of Astrogeologic Studies of the United States Geological Survey. Raised in northern New Mexico, Larry attended New Mexico Institute of Mining and Technology, receiving bachelor's degrees in both geology and physics. He then entered Caltech and received a Ph.D. in planetary science and geophysics. Since joining the Branch of Astrogeologic Studies in 1970, Larry has been engaged in a broad spectrum of planetary research tasks, including theoretical modeling of planetary surface processes, telescopic instrument development and observations, determination of the global time scales and evolutionary sequences for the crusts of the terrestrial planets, establishment of an advanced computer-image-processing facility geared toward planetary and terrestrial geologic applications, and making global maps of surface materials on the terrestrial planets based on various remote sensing data acquired by ground-based and spacecraft systems. Larry has participated in several of NASA's unmanned space exploration missions, including Mariner 6, 7, and 9 and the Viking mission to Mars. Currently he is the deputy team leader for the Voyager Imaging Science Experiment that was responsible for the spectacularly successful encounters with Jupiter, including discovery of active volcanos on Io.

David W. Strangway. A member of AGU since 1960, he is currently vice president and provost of the University of Toronto. He obtained his B.A., M.A., and Ph.D. in 1956, 1958, and 1960, respectively, from the University of Toronto. His work was on the magnetic properties of Precambrian rocks. He spent the summers from 1952 to 1959 working for mining and petroleum companies in exploration geophysics. The year 1956/57 was spent as chief geophysicist for Ventures Ltd. and 1960/61 as a research geophysicist for the Bear Creek Mining Company (Kennecott Copper Corporation). He has been on the faculty of the University of Colorado (geology, 1961–1964), MIT (geophysics, 1965–1966), and University of Toronto (physics, 1999–present, and geology, 1972–present) as well as a visiting professor at the University of Houston (1971–1973). From 1970–1973 he was at the Manned Spacecraft Center in Houston, Texas, where he headed up the geophysics branch and, later, the Planetary and Earth Sciences Division. He served for a short period as the director of the Lunar Science Institute and was the first chairman of the Lunar Science Council of the Universities Space Research Associates. He has served on a variety of committees dealing with lunar and planetary science and on a number of visiting committees, including one to the Geological Survey of Canada.

He has been awarded the NASA medal for Exceptional Scientific Achievement and the SEG Virgil Kauffman gold medal; was elected to the Royal Society of Canada in 1974; and is an honorary member of the Canadian Society of Exploration Geophysicists.

He has served on the editorial boards of a number of journals and has been president of the Geological Association of Canada (1978/79) and chairman of the Canadian Geophysical Union (1977/79) and the Ontario Geoscience Research Fund. He has taken an active involvement in the affairs of the American Geophysical Union, the Society of Exploration Geophysicists, and the Canadian Exploration Geophysicists (KEGS) and is currently the secretary of AGU's Planetology Section.

He has authored or coauthored one book and over 100 papers dealing with magnetic and electrical methods as applied to geological problems. These range from studies of lunar samples and meteorites to planetary evolution, exploration geophysics, crustal sounding, and methods for waste disposal.

Planetology: Secretary

Thomas B. McCord. Age 42; a member of the American Geophysical Union since 1965. He was elected a fellow of AGU in 1975. He is professor of planetary sciences at the University of Hawaii and head of the Planetary Geosciences Division of the Hawaii Institute of Geophysics. He also is senior research scientist of the Massachusetts Institute of Technology. His areas of scientific interests include the structure and composition of planetary surfaces, including the earth, using remote sensing techniques. He holds a B.A. in physics (1964) from Penn State University, M.S. in geology (1966) and Ph.D. in planetary sciences and astronomy from the California Institute of Technology (1968). McCord was a professor of planetary physics in the Department of Earth and Planetary Science at MIT from 1968 to 1976, when he resigned. He was chairman of the Division of Planetary Science of the American Astronomical Society, 1990, and he is now past chairman. He is a fellow of the AAAS and is a member of a wide variety of professional scientific and engineering societies. He is and has been a member of many government and NAS advising committees and maintains an interest in national science policy and the health of research capability in the physical sciences. He has published over 150 scientific articles, including 10 in the past year. He acts as a part-time science correspondent for a local TV station and co-hosts a weekly radio show designed to communicate the excitement and knowledge associated with research.

Joseph Veverka. Age 40; a member of the AGU since 1979. He is an associate professor of astronomy at Cornell, a member of the university's Laboratory for Planetary Studies, and the director of the Spacecraft Planetary Imaging Facility. His areas of scientific interest include planetary surfaces and atmospheres, photometry, and the small bodies of our solar system. He holds B.Sc. (1964) and M.Sc. (1965) degrees from Queen's University (Kingston), and M.A. (1970) and Ph.D. (1970) degrees from Harvard. He is the chairman of NASA's Comet Science Working Group, concerned with the exploration of Halley's comet on its return in 1986, and a member of other space science advisory groups. In addition to the AGU he belongs to the American Astronomical Society, the Royal Astronomical Society of Canada, the International Astronomical Union, and the Meteoritical Society. He is a member of the Voyager and Galileo Imaging Science teams and has previously participated as an imaging science investigator in the Mariner 9 and Viking missions to Mars. In 1979 he was awarded NASA's Medal for Exceptional Scientific Achievement for his investigations of the moons of Mars. He is the author or coauthor of more than a hundred scientific papers. Veverka currently serves on the editorial board of *Icarus* and is an associate editor of JGR (Red).

Seismology: President-Elect

Michael A. Chinnery. Joined AGU 1961. Age. 47. Current position: leader, Applied Seismology Group, Lincoln Laboratory, MIT. Research interests: seismology, seismic discrimination, seismic data management systems, seismic risk. New England earthquakes, earthquake mechanism, fault mechanics, polar motion, space geodesy, geodynamics. Degrees: B.A. (Cambridge, 1957), M.A. (Toronto, 1959), M.A. (Cambridge, 1991), Ph.D. (Toronto, 1962), D.Sc. (Cambridge, 1977). Employment: Dep. of Geophys., University of B.C. (assistant professor, 1962–95); Dep. of Earth and Planet Sci., MIT (research associate, 1965–66; Dep. of Geol. Sci., Brown University (associate professor, professor, 1966–73); Lincoln Laboratory, MIT (1973–present). Memberships: Seismological Society of America; Eastern Section, Seismological Society of America (chairman, 1973–75; Executive Committee, 1975–77); Royal Astronomical Society (Fellow); and others. NASA: Earth Dynamics Advisory Subcommittee (chairman, 1977–79); Geology/Geodynamics Advisory Subcommittee (chairman, 1978–81); Space and Terrestrial Applications Advisory Committee (member, 1978–81). NAS/NRC: GRB/GSC Study on Geodynamics Data Policy (chairman, 1979–present); member of various panels and working groups. IUGG/IUGS: working group to formulate postgeodynamics program, 1979. ICL: coordinating committee on data centers and data exchange (chairman, 1981–present). ICSU: panel on world data centers (solid earth representative, 1981–present). Publications: 38 (three in AGU journals), plus numerous abstracts, reviews, and reports, includes early work in fault mechanics, stress drop in earthquakes, seismic risk in eastern U.S., saturation of magnitude scale. Secretary, AGU Tectonophysics section, 1968–70. Secretary, AGU Seismology section, 1980–82. Program chairman, Tectonophysics, 1969 and 1970 AGU Spring Meetings. Associate editor, JGR, 1969–72. Associate editor, GRL, 1974–79. AGU Committee on Education and Human Resources (member, 1978–present).

Lynn R. Sykes. A member of AGU since 1961, he is 43 years of age. Sykes is currently Higgins Professor of Geological Sciences at Columbia University and head of the Seismology Group at Lamont-Doherty Geological Observatory. He received his B.S. and M.S. at the Massachusetts Institute of Technology in 1960 and his Ph.D. from Columbia University in 1965. He was a research assistant (1961–64) and research associate in seismology (1964–68) at Lamont-Doherty Geological Observatory. Last employed in the Earth Sciences Laboratories, Environmental Science Services Administration of the Department of Commerce and adjunct assistant professor of geology at Columbia University from 1999 to 1968. He is a member of the U.S. National Academy of Science, The American Academy of Arts and Sciences, and is a fellow of AGU, AAAS, Geological Society of America, and the Royal Astronomical Society. He has published 73 articles, a total of 30 in AGU journals. The most important recent articles are 1978, "Earthquakes, faults, and nuclear power plants in southern New York–northern New Jersey," and 1979, "Intraplate seismicity, reactivation of preexisting zones of weakness, alkaline magmatism, and other tectonics postdating continental separation;" 1990, "Rupture zones of great earthquakes, Alaska-Aleutian arc, 1784–1990;" and 1991, "Repeat times of great earthquakes along simple plate boundaries." His 1997–8 & 9 papers are his three most important contributions (1997, "Mechanism of earthquakes and nature of faulting on the midoceanic ridges," *J. Geophys. Res., 72*; 1998, "Seismology and the new global tectonics," with B. L. Isacks and J. Oliver, *J. Geophys. Res., 73*, 1999, Tectonics of the Caribbean and Middle America regions from focal mechanisms and seismicity," with P. Molnar, *Bull. Geol. Soc. Am.*). He was a recipient of AGU Macelwane and Buchar awards and is a Sloan Fellow. He has served as president of the Section of Tectonics (1972–74), as an associate editor of JGR, and on the Publications Committee. His present areas of interest include earthquake prediction and the tectonics of Alaska, the Caribbean, and the eastern United States.

Seismology: Secretary

Thomas H. Jordan. Joined AGU in 1969. He is 32 years old and currently an associate professor of geophysics at the Scripps Institution of Oceanography, University of California, San Diego. Jordan's primary research interests are in the fields of seismology and tectonics; much of his work has been aimed at elucidating dynamical processes within the earth by the seismological study of Earth structure. He received his B.S. (1969) and Ph.D. (1972) degrees from the California Institute of Technology and was on the faculty of Princeton University for 3 years before moving to Scripps in 1975. He has authored 40 scientific publications (including 14 in AGU journals) and was recently awarded an Alfred P. Sloan Fellowship. He is a member of the AGU Meetings Committee and an associate editor of JGR. His recent publications include: Structural geology of the Earth's interior, *Proc. Nat. Acad. Sci. USA, 76*, 4192–4200, 1979; The deep structure of the continents, *Sci. Am., 240*, 92–107, 1979; A procedure for estimating lateral variations from low-frequency eigenspectra data, *Geophys. J. R. Astron. Soc., 52*, 441–445, 1978; and Lithospheric slab penetration into the lower mantle beneath the Sea of Okhotsk, *J. Geophys., 43*, 473–496, 1977.

Robert B. Smith. A member of AGU since 1967, he is 42 years old. He is currently professor of geophysics and director of seismograph stations, Department of Geology and Geophysics, University of Utah. His areas of scientific interest are theory and methods in evaluation of earthquake hazards and feasibility of earthquake prediction in continental zones of intraplate seismicity, long-time seismic profiling using refraction and wide-angle reflection techniques for crustal structure, and kinematics and quantitative models of interplate tectonics in continental regions, including seismic evaluation of mechanics of mountain building and emplacement of magmas. He received his B.S. and M.S. from Utah State University in 1960 and 1965, respectively, and his Ph.D. in 1967 from the University of Utah. He was geodetics and geophysics officer in the U.S. Air Force, 1961–64; U.S. exchange scientist

to the British Antarctic Survey, 1962–1963; graduate research assistant at the University of Utah, 1965–1967; and since 1967, has been a faculty member at the University of Utah. In 1969 he was visiting research scientist at Lamont-Doherty Geological Observatory and in 1976–1977, visiting professor of the Geophysics Institute of the Swiss Federal Institute of Technology in Zurich. He has published a total of 69 papers, 16 of them in AGU journals. Representative publications include "Contemporary tectonics and seismicity of the Western United States with emphasis on the Intermountain Seismic Belt," *Bull. Geol. Soc. Am.*; "Yellowstone Hot Spot, crustal properties from new earthquake and magnetic data," *Journal of Geophysical Research*; "Seismicity, crustal structure, and intraplate tectonics of the western Cordillera," in *Cenozoic Tectonics and Regional Geophysics of the Western Cordillera*; "The Yellowstone-Snake River Plain Seismic Profiling Experiment: General crustal structure of the Yellowstone region and experiment design," in press, *Journal of Geophysical Research*, 1981. He received the Faculty Research Award at the University of Utah in 1979 and the University of Utah Distinguished Research Award 1980. He was organizer of the 1974 AGU Symposium on Yellowstone and coorganizer of the 1979 AGU Symposium on the Yellowstone-Snake River Plain. He is a member of the National Academy of Sciences, Committee on Seismology.

Solar Planetary Relationships: President-Elect

George C. Reid. Born in Edinburgh, Scotland, in September 1929 and was educated at Edinburgh University, graduating in 1950 with a first-class honors degree in physics and in 1954 with a Ph.D. in nuclear physics. Following a year's postdoctoral fellowship at the National Research Council of Canada, in Ottawa, he joined the staff of the Canadian Defense Research Telecommunications Establishment, where he stayed until 1963, with a 2-year break as associate professor of geophysics at the University of Alaska in Fairbanks in 1958–60. In 1963 he joined the Commerce Department Laboratories in Boulder, Colorado, where he has remained until now. He is presently deputy director of the Aeronomy Laboratory of NOAA, and he has also held a position as one of the initial Fellows of the Cooperative Institute for Research in the Environmental Sciences at the University of Colorado (1968–73).

His research interests and contributions have ranged from studies of the acceleration and propagation of solar protons, through magnetospheric, auroral, and ionospheric plasma physics, to investigations of the ion chemistry of the lower ionosphere. Most recently he has been involved in studies of the effects of changing solar radiation on global climate. He served as editor of the *Journal of Geophysical Research* (Space Physics) from 1973 to 1977 and was elected a Fellow of the AGU in 1977. He is a member of the National Academy's Committee on Solar-Terrestrial Research and chairman of their Panel on the Middle Atmosphere Program.

C. T. Russell. A research geophysicist with the Institute of Geophysics and Planetary Physics of the University of California, Los Angeles. His principal research interests are terrestrial and planetary magnetism and solar terrestrial relations, and in pursuing such interests he is heavily involved in NASA's spacelight program—being principal investigator on both the International Sun Earth Explorer and Pioneer Venus Orbiter missions and an interdisciplinary scientist on the Galileo mission to Jupiter. He is a recipient of the Macelwane Award (1977) and a fellow of both the AGU and the AAAS. He is a member of the executive committee of commission D of COSPAR on Space Plasmas in the Solar System; a member of the COSPAR panel on Potentially Environmentally Detrimental Activities in Space, chairman of the IAGA Working Group on the Auroral Oval and its Extension into Space, chairmen of the URSI Working Group on Active Experiments, a member of the executive committee of USNC/URSI Commission H, a member of the European Geophysical Society, the American Association for the Advancement of Science, and an affiliate member of the DPS of the AAS, and of course a long-time member of the AGU. Among the various advisory committees he serves on the Space Science Advisory Committee of NASA.

He has served the AGU in many capacities. He was associate editor of JGR from 1976–1978, of GRL from 1979–1981, and of Eos from 1979–1982. He is AGU's representative to the U.S. National Committee of URSI. He has served on the Education and Human Resources Committee from 1977–present and is presently the chairman of that committee. He is a frequent user of AGU services. He has authored or coauthored over 100 articles in AGU journals, including JGR, GRL, RSGP, and Eos, and he has authored or coauthored over 150 invited and contributed talks at the spring and fall annual meetings. Finally, he has attended every Spring and Fall AGU Meeting since 1966, with the exception of the December 1979 meeting when he was at the simultaneous IUGG assembly in Australia.

SPR Aeronomy: Secretary

Raymond G. Roble. He has been a member of the AGU since 1969, is 46 years old, and is currently a senior scientist at the National Center for Atmospheric Research (NCAR). B.S.E., 1957; M.S.E., 1961; and Ph.D. (aeronomy) in 1969, all from the University of Michigan; 1957–1960, Engineer Officer, U.S. Navy; 1961–1964, engineer at the Bendix Research Laboratories; 1969–1970, postdoctoral fellow in the Advanced Study Program at NCAR; 1970–present, scientist at NCAR; lecturer, Department of Astrogeophysics, University of Colorado, 1978–present. Current research interests include thermospheric dynamics, ionospheric chemistry and dynamic interactions; thermospheric and mesospheric aeronomy; global atmospheric electricity; auroral processes; 86 scientific papers published, 38 published in AGU journals. Outstanding Publication Award, NCAR, 1980; guest investigator for the Atmospheric Explorer satellite team, theoretical investigator for the Dynamics Explorer satellite team, member of the National Academy of Sciences' Geophysics Study Committee and Committee on Solar and Space Physics, member of various other NASA, URSI, and NAS panels and working groups, member AGU Subcommittee for Publicity, 1977–present, associate editor, blue JGR, 1979–1982.

SPR Cosmic Rays: Secretary

S. P. Duggal. A member of AGU since 1961, he is 49 years old. He received his B.S. and his M.S. at St. Stephen's College and Delhi University in 1951 and 1953, respectively, and his Ph.D. in physics from Gujrat University, India, in 1959. He is currently with the Bartol Research Foundation of the Franklin Institute of the University of Delaware. Working the the area of cosmic ray research, he began there in 1960, became assistant professor in 1967, associate professor in 1973, and professor in 1978. Prior to that he was a senior research fellow at the Physical Research Laboratory in India (1958–60). He is a fellow of the American Physical Society, life member of the American Geophysical Union, and a member of the American Association of Physics Teachers, Sigma Xi, and AAAS. He is the author or coauthor of more than 90 papers in the area of cosmic rays physics.

Miriam Forman. Age 42; a member of the AGU since 1963. Adjunct associate professor in the Department of Earth and Space Sciences at the State University of New York, Stony Brook. Areas of scientific interest include the theory of propagation and acceleration of energetic solar and galactic particles in the heliosphere, as defined by reported contemporary ground and spacecraft measurements, and of long-term variations of cosmic rays inferred from radiochemical studies of the earth, meteorites, and lunar samples. Most active current interest is the theory of acceleration of particles by shocks, including the earth's bow shock, propagating interplanetary shocks, and stellar wind terminal shocks.

B.S. (1960) and M.S. (1961) degrees from University of Chicago; Ph.D. in physics from Stony Brook in 1972. Adjunct faculty at Stony Brook since 1973, supported on NASA grants. Visiting senior research scientist at the Max-Planck Institut für Kernphysik 1976–1979. Member of AGU, American Astronomical Society, and American Physical Society; member of the executive committee of the Cosmic Physics division of the APS 1980–1982. Published 25 papers, including 10 in AGU journals, and contributed 10 to AGU meetings.

SPR Magnetospheric Physics: Secretary

Theodore A. Fritz. Age 41; joined AGU in 1962. He is a research physicist with the Space Environment Laboratory of the NOAA Environmental Research Laboratories in Boulder, Colorado. His scientific interests include magnetospheric and radiation belt physics and solar-terrestrial relationships, along with spacecraft program and instrumental aspects to carry out these studies. He received the B.S. degree in physics from Virginia Polytechnic Institute, Blacksburg, in 1961 and the M.S. and Ph.D. degrees in physics from the University of Iowa, Iowa City, in 1964 and 1967, respectively.

He was involved in the design, fabrication, and calibration of a number of scientific experiments flown as part of the University of Iowa satellite programs, Injun-3 and Injun-5, and the NASA satellite program OGO-4. He was a research associate in the Department of Physics and Astronomy of the University of Iowa during the school year 1967–1968. From 1968 to 1969 he was a postdoctoral fellow of the National Research Council of Canada, Ottawa, where he worked on data sets obtained simultaneously from satellites Injun-3 and Alouette-1. From 1970 to 1971 he was an NRC/NAS Postdoctoral Resident Research Associate of the NASA Goddard Space Flight Center, Greenbelt, Md., where he became involved in the design, construction, and calibration of similar experiments for the NASA/Explorer-45 and ATS-6 satellite programs. Since 1971 he has been with the NOAA Space Environment Laboratory in Boulder, Colo. He was involved in the NASA/TIROS-N space environment monitoring definition and is an investigator on experiments flown on the NASA/ISEE 1 and 2 spacecraft launched in October 1977, a number of DoD programs including SCATHA, as well as the NASA/Galileo probe to Jupiter and the Swedish Viking program to be launched in the future. During 1973 and again in the summer of 1978 he was a visiting scientist in residence at the Max-Planck Institut for Aeronomy, Lindau/Harz, Germany, and he was a member of the NASA Science Definition Working Group for the future OPEN (Origins of Plasmas in the Earth's Neighborhood) program. He has about 50 scientific publications, over half of which are in the *Journal of Geophysical Research*.

Michael Schulz. Age 38; he joined the AGU in 1967. He is a research scientist with The Aerospace Corporation in El Segundo, California. His scientific interests include theoretical plasma physics, magnetospheric and radiation-belt physics, solar wind, and solar-terrestrial relationships. He earned his B.S. degree in physics from Michigan State University in 1964 and his Ph.D. degree, also in physics, from the Massachusetts Institute of Technology in 1967. He held an Alumni Distinguished Scholarship at MSU and a National Science Foundation Fellowship at MIT. He worked during the summers of 1964 and 1965 in the Polymers Division of the National Bureau of Standards. In 1967, Schulz became a member of the technical staff at Bell Telephone Laboratories in Murray Hill, New Jersey. He joined the Space Sciences Laboratory of The Aerospace Corporation in 1969 and continues to investigate plasma and radiation-belt dynamics. He has been a fellow of the American Physical Society since 1977 and a member since 1964. He has authored or coauthored more than 60 scientific articles that have been published in various journals and books, including about 30 in AGU publications. He also coauthored (with L. J. Lanzerotti) the monograph *Particle Diffusion in the Radiation Belts* (Springer, 1974). Schulz has served as referee for various journals (1968–present), as associate editor of the *Journal of Geophysical Research* (1976–1978), and as organizer of the Space Sciences Laboratory Seminar (1978–1979). He has served the AGU as secretary of magnetospheric physics since July 1980.

SPR Solar and Interplanetary Physics: Secretary

Leonard F. Burlaga. Member of AGU since 1966. Age, 42. Physicist. B.S., University of Chicago, 1960; M.S., University of Minnesota, 1962; Ph.D., University of Minnesota, 1965. Employed at NASA/Goddard Space Flight Center since 1965, initially as a National Academy of Sciences/National Research Council Postdoctoral Resident Research Associate (1966–1968). Visiting scientist at the High Altitude Observatory in Colorado and at the Laboratorio Plasma Spazio in Italy. Research interests include interplanetary magnetic fields and plasmas, magnetohydrodynamics, interaction of the solar wind with planets and comets, and magnetospheric physics. Coinvestigator on several satellite experiments, including experiments on Voyager, Helios, and Explorers 34, 41 and 43. Author of more than 70 scientific articles. Recipient, NASA Exceptional Scientific Achievement Medal, 1976. Committee memberships include Solar and Heliospheric Physics Management Operations Working Group; Interplanetary Physics Working Group; Comet Science Working Groups; and Working Groups for OPEN, Plasma Turbulence Explorer, Solar Corona Explorer, and the Solar Cycle and Dynamics Mission. Member, American Physical Society; International Astrophysical Union; Chairman, Division IV of the International Association of Geomagnetism and Aeronomy.

Bruce T. Tsurutani. B.A., Ph.D., University of California at Berkeley. Has been at the Jet Propulsion Laboratory, California Institute of Technology, since 1972 and is presently a member of the technical staff in the Space Physics Section. Author or coauthor of 53 scientific articles. Areas of scientific interest include interplanetary physics (heliospheric magnetic field properties and configuration, cosmic ray modulation), solar wind interaction with magnetospheres (upstream waves and particles, magnetic merging, viscous interaction), plasma physics (instabilities and wave-particle interactions), particle acceleration processes (interplanetary and magnetospheric), auroral physics (particle precipitation and substorms), astrophysics (X ray bursters). He is a member of the American Geophysical Union, the American Association for the Advancement of Science, Sigma Xi, the New York Academy of Sciences, and the International Union of Radio Science. Currently a coinvestigator on the International-Sun-Earth-Explorer (ISEE-3) Interplanetary Magnetic Field Investigation; a coinvestigator on the European Space Agency International Solar Polar Mission Magnetic Field investigation, and a guest investigator on the ISEE 1 and 2 plasma wave, plasma, and magnetic field experiments. Served as a member of the NASA Plasma Turbulence Explorer Study Group and the NASA Solar Polar Mission Study Group. Coorganized an ISEE Upstream Wave and Particle Meeting and a special issue of JGR.

Tectonophysics: President-Elect

Thomas J. Ahrens. A member of AGU since 1959; age 44. He is currently professor of geophysics at the California Institute of Technology. His research interests include physics of the earth's interior, especially equation of state of rocks and minerals, including polymorphism and dynamic yielding. Also, impact processes on planetary surfaces and theories of accretion and evolution of volatiles on the terrestrial planets. Borehole in-situ stress and tilt measurements. He received his B.S. from the Massachusetts Institute of Technology, 1957; his M.S. from California Institute of Technology, 1958; and his Ph.D. from Rensselaer Polytechnic Institute, 1962. He served as a geophysicist with the Pan American Petroleum Corporation, 1958–1959; a 2nd Lieutenant, U.S. Army, 1959–1960; as a geophysicist at the Stanford Research Institute, 1962–1967, prior to coming to the California Institute of Technology in 1967. He has served as president, (San Francisco) Bay Area Geophysical Society, 1966–1967; associate editor, *Journal of Geophysical Research*, 1972–1974; associate editor, *Review of Scientific Instruments*, 1972–1974; NSF Earth Sciences Advisory Panel, 1973–1978; chairman, Geophysics Gordon Research Conference, 1974; president, Sigma Xi, Caltech chapter, 1974–1975; advisory editor, *Physical Chemistry of Minerals*, 1976–present; NASA Lunar and Planetary Review Panel, 1976–1980; Advisory Committee, Division of Earth Sciences NSF, 1976–present; editor, *Journal of Geophysical Research* (Red), 1979–1982. He has published 113 papers, 32 in AGU journals; the most important are: Calculated mineral reactions in the earth's mantle (JGR, 1967); The basalt-eclogite reaction rate and its geophysical significance (*Reviews of Geophysics and Space Physics*, 1975); Impact-induced energy partitioning, melting, and vaporization on terrestrial planets (*Proc. 8th Lunar Science Conference*); Equation of state of iron sulfide and constraints on the sulfur content of the earth (JGR, 1979).

Johannes Weertman. A member of AGU since 1958; age 58. He is currently Walter P. Murphy Professor of Materials Science and Engineering, the Department of Materials Science and Engineering, and professor of geophysics, Department of Geological Sciences, Northwestern University, where he has been since 1959. His areas of scientific interest include dislocation theory, creep of crystalline solids, glacier mechanics, geothermal energy, fatigue, and fracture solids. He received his B.S. (1948) and D.Sc. (1951) in physics at Carnegie Institute of Technology (now Carnegie-Mellon University). He was a Fulbright Fellow 1951–1952 at the Ecole Normale Superieure in Paris; with the Naval Research Laboratory from 1952 to 1956; with the ONR-London 1956–1959; a visiting professor in geological sciences at Caltech 1964; and Guggenheim Fellow at Scott Polar Research Institute of Cambridge University (1970–1971). He received the Robert E. Horton Award of the Hydrology Section of AGU in 1962 for a paper in JGR on stability of ice age sheets; the Champion H. Mathewson Gold Medal of AIME in 1977; and Acta Metallurgica Gold Medal in 1980. In 1978 he was elected to membership in the National Academy of Engineering. He has served as an associate editor of JGR (1972–1975) and on the Committee on Glaciers (1961–1969), where he served as chairman (1966–1969). He is the author or coauthor of over 200 publications, including 20 in AGU journals. He is coauthor coeditor of two books. He is a fellow of the American Society for Metals, The American Physical Society, and the Geological Society of America. He is a member of AIME, AAAS, the International Glaciology Society, Arctic Institute of North America, American Quaternary Association, ASTM, European Geophysical Society. He was chairman of the 1969 Gordon Conference on physical metallurgy, editorial advisor to the *Journal of Glaciology* (1972–present), and served on various committees of AIME, ASM, and NAS/NAE.

Tectonophysics: Secretary

Christopher Scholz. Age 38, is professor of geological sciences at Lamont-Doherty Geological Observatory of Columbia University. A member of AGU since 1967, he received a B.S. from the University of Nevada in 1964 and a Ph.D. from MIT in 1967. He joined L-DGO following a postdoctoral year at Caltech. A past member of the U.S. National Committees on seismology and on rock mechanics, he was a Sloan Fellow in 1975–1977 and a Cecil and Ida Green Scholar at IGPP, U.C. San Diego, 1980–81. Author of 62 papers, 25 in AGU journals, his principal work has been on fracture and friction of rock, the mechanism of earthquakes and faulting, and general and regional studies of tectonics. Representative recent papers on those subjects can be found in JGR (*83*, p. 763, 1978; *84*, p. 5525, 1979; and *84*, p. 6770, 1979).

Joseph B. Walsh. Joined AGU in 1975; age 50. Currently a senior research scientist in the Department of Earth and Planetary Sciences, MIT. His scientific work is primarily theoretical, involving the application of mechanics to problems in tectonophysics, such as faulting and the elastic and anelastic properties of rock. He received his B.S. degree from MIT in 1952 and his Ph.D. from MIT in 1956. After graduation he worked for consulting engineering companies for several years. He came to the Woods Hole Oceanographic Institution in 1960 and left in 1963 to join the research staff at MIT. He has written 42 scientific articles, of which 22 appeared in AGU journals. The most interesting of these are his work on the effect of cracks on the elastic properties of rock (*JGR*, *70*(2), 381, 1965), the role of pore fluid or interstitial melt on wave velocities and attenuation (*JGR*, *74*(17), 4333, 1969), and the changes in gravity resulting from faulting (*JGR*, *84*(B1), 165, 1976). He served as associate editor of *JGR* for the period 1975–77.

Volcanology Geochemistry and Petrology: President-Elect

G. Brent Dalrymple. Age 44; a member of AGU since 1963, fellow since 1975; currently regional geologist, Western Region, U.S. Geological Survey. Areas of current interest include history of geomagnetic field, origin of linear volcanic chains, geology of Hawaiian islands, evolution of volcanic systems, origin and evolution of seamounts, development of radiometric dating techniques. A.B., Occidental College, 1956; Ph.D., University of California, Berkeley, 1963. Employed by U.S. Geological Survey 1963–present; lecturer and research associate, Stanford University 1969–1971; visiting professor, Stanford, 1972. Fellow, Geological Society of America; member, American Quaternary Association; councilor, American Quaternary Association, 1971–1972; American Commission on Stratigraphic Nomenclature, 1973–1978. More than 80 published papers, the most important of which include a series on geomagnetic reversals, a series on the origin of the Hawaiian islands, and a book on K-Ar dating. Member, AGU Monograph Board, 1971–1973, and secretary of the VGP Section since 1980.

Heinrich D. Holland. Age 54; a member of AGU since 1960 and a fellow since 1973. He is currently professor of geochemistry at Harvard University and is occupied with research dealing with the chemistry and chemical evolution of the atmosphere and oceans and with the nature of hydrothermal solutions. He received his B.A. (1946) in chemistry from Princeton University, his M.S. (1948) and Ph.D. (1952) degrees in geology from Columbia University. An honorary M.A. (1972) was conferred by Harvard University when he joined the faculty there. He was a member of the faculty of Princeton University from 1950 to 1972. During this time he was also an NSF Postdoctoral Fellow at Oxford University (1956–1957), a Fulbright Fellow at Durham University and Imperial College, London (1963–1964), and a visiting professor at the University of Hawaii (1968–1969). Since joining Harvard University (1972), he has held a Guggenheim Fellowship (1975–1976), received a Humboldt Award (1980) tenable at Heidelberg University, and was a visiting professor at the University of Hawaii (1981). He is a member of the National Academy of Arts and Sciences, the Geochemical Society, the Geological Society of America, the Society of Economic Geologists, the Mineralogical Society of America, the American Association for the Advancement of Science, and the International Association of Geochemistry and Cosmochemistry. He has held all of the major offices in the Geochemical Society. He has published two books and approximately 100 papers and is currently completing a book dealing with the chemical evolution of the atmosphere and oceans. He was chairman of the Bowie Medal Committee of the AGU from 1978 to 1980.

Volcanology, Geochemistry and Petrology: Secretary

J. Lawford Anderson. Age 33; a member of AGU since 1975. He is presently an associate professor of geology at the University of Southern California, Los Angeles. Principal research interests are in the fields of igneous petrology, petrochemistry, and mineral equilibria. A native of Goose Creek, Texas, he holds a B.A. (1970) in geology from Trinity University and a M.S. (1972) and Ph.D. (1975) in geology from the University of Wisconsin (Madison). Anderson has been teaching at USC since 1975. In addition to AGU he is a member of the Geological Society of America, American Association for the Advancement of Science, and Sigma Xi. For the past 3 years he has served on the Abstract Review Panel for the Cordilleran Section of GSA. He has published over 13 papers and 19 abstracts (three in AGU publications) that deal primarily with the evolution of granitic magmas, specifically their generation, crystallization, deformation, and associated tectonic setting. Recent work has centered on the mineralogy and petrology of anorogenic granite plutonism of the late Precambrian of North America, Mesozoic-to-Tertiary two-mica granites of the southwestern U.S., and conditions of mylonitization and other forms of cataclasis in Cordilleran metamorphic complexes. The following 1960–1981 publications are representative of his present research:

Anderson, J. L., Mineral equilibria and crystallization conditions in the Late Precambrian Wolf River rapakivi massif, Wisconsin, Am. *J. Sci.*, *280*, 2369–332, 1980.

Anderson, J. L., R. L. Cullers, and W. R. Van Schmus, Anorogenic metaluminous and peraluminous granite plutonism in the Mid-Proterozoic of Wisconsin, U.S.A., *Contrib. Mineral. Petrol.*, *74*, 311–328, 1980.

Anderson, J. L., R. H. Osborne, and D. F. Palmer, Petrogenesis of cataclastic rocks within the San Andreas Fault Zone of southern California, U.S.A., *Tectonophysics*, *67*, 221–249, 1980.

Anderson, J. L., and M. C. Rowley, Synkinematic intrusion of peraluminous and associated metaluminous granitoid magmas, Whipple Mountains, California, *Can. Mineral.*, *19*, 83–101, 1981

Davis, G. A., J. L. Anderson, E. G. Frost, J. J. Shackelford, Mylonitization and detachment faulting in the Whipple-Buckskin-Rawhide Mountains terrane, southeastern California and western Arizona, in Metamorphic Core Complexes, edited by M. Crittenden, G. H. Davis, and P. J. Coney, *Geol Soc. Am. Mem*, *153*, 79–129, 1980

Peter W. Lipman. Age 46, a member of AGU since 1967. He has worked for the U.S. Geological Survey in Denver, Colorado, since completing his Ph.D at Stanford University in 1962. Lipman's primary scientific interests concern broad aspects of volcanism, including field geology, relations between volcanism and subvolcanic intrusions, geochemistry and isotopic chemistry of magmas, structural features of volcanic rocks, relations between volcanism and plate tectonics, the role of volcanism in planetary evolution, geodetic monitoring and hazards analysis of active volcanos, volcanic activity in relation to geothermal energy, and significance of volcanism to ore deposition. Lipman has been project chief of several of several USGS studies of Cenozoic volcanic centers in Colorado, New Mexico, Utah, and Nevada. In addition he has worked on active volcanos in Japan, Hawaii, and most recently, on the 1980 eruption of Mount St. Helens. Lipman has authored or coauthored approximately 175 scientific articles and papers. He is currently coeditor of the USGS Professional Paper on the 1980 eruptions of Mount St. Helens, Washington, and is also an editor for the Cordilleran volume of the Geological Society of America's centennial publication series 'Decade of North American Geology.' Lipman is a fellow of the Geological Society of America and the Mineralogical Society of America; in 1980 he was made an honorary member of the Colorado Scientific Society.

Meetings

1981 AGU Fall Meeting

The 1981 Fall Meeting will be held at the Jack Tar Hotel and the Holiday Inn/Golden Gateway in San Francisco from December 7-11.

Registration

Everyone who attends the meeting must register. Preregistration (received by November 17) saves you time and money, and the fee will be refunded if AGU receives written notice of inability to attend by November 30. Registration rates are as follows:

	Preregistration	At-Meeting (after 11/17)
Member	$55	$70
Student Member	$25	$40
Nonmember	$75	$90
Student nonmember	$32	$47

Registration for 1 day only is available at one half the above rates. Members of the American Meteorological Society, the American Society of Photogrammetry, Union Geofisica Mexicana and the American Congress on Surveying and Mapping may register for the meeting at the AGU member rates.

The difference between member (or student member) registration and nonmember registration may be applied to AGU dues if a completed membership application is received at AGU by February 13, 1982. Current AGU annual membership rates are: $20 members; $7 student members.

To preregister, fill out the registration form, and return it with your payment to the AGU Office. Your receipt will be included with your preregistration material at the meeting. *Preregistrants should pick up their registration material at the preregistration desk at the Holiday Inn/Golden Gateway Hotel.* Complimentary badges for guests not attending the scientific sessions will be available at the registration desk.

Scientific Sessions

The scheduling of the scientific program will be published in EOS, October 20. Both hotels will be utilized for all disciplines.

Hotel Accommodations

A block of rooms ($41 singles; $47 doubles) is being held for meeting attendees at the Jack Tar Hotel and at the Holiday Inn/Golden Gateway. Reservations are processed as they are received, so if you wish to stay at a particular hotel, you should make your reservation as early as possible. Remember your fellow scientists need a room. Reserve in one hotel only. *Don't be a no-show!*

Reservations must be received by November 12 to be confirmed. Please use the form provided to be assured of the special AGU rate, and mail it directly to the hotel of your choice. Do not write or call the AGU office for room reservations.

Free parking is available only to registered guests of each hotel.

Social Events

Two parties are planned for registrants. The Ice Breaker will be on Monday at the Jack Tar Hotel; and a wine and cheese party on Thursday at the Holiday Inn/Golden Gateway Hotel.

Complimentary refreshments will be served daily at both hotels from 9:30 to 10:30 A.M. and 2:30 to 3:30 P.M.

Business Meetings and Sections Luncheons/Dinner

The AGU Council will meet Sunday at 5:00 pm in the Japonsas Pavillion (formerly the Garden Room) of the Jack Tar Hotel.

The Tectonophysics section business meeting will follow an afternoon technical session (TSA).

The Nikko, Van Ness and Pine; the Casa da Cristal, 1122 Post Street; and the Four Seas, 731 Grant Avenue, are the restaurants that will provide an atmosphere of conviviality for the section luncheons and dinner as listed below:

Tuesday, December 8

Geodesy Seismology	Casa de Cristal Nikko	noon noon	$8.00 $3.75 (subsidized)

Wednesday, December 9

Hydrology Oceanography	Casa de Cristal Nikko Banquet room	noon noon	$8.00 $8.25
Meteorology	Nikko (T/K room)	11:45 a.m.	$8.25
Solar-Planetary Relationships	Four Seas	6:00 p.m.	$12.00 (subsidized)

- Special Chinese Gourmet Banquet
- Business meeting at 8 p.m., followed by the banquet at 7:30. Reservations in advance required

Thursday, December 10

Planetology/ Volcanology, Geochemistry, and Petrology	Nikko Banquet room	noon	$8.25

- An opportunity for members of both sections to meet in an informal atmosphere to discuss subjects of mutual interest.

Geomagnetism and Paleomagnetism	Nikko (T/K room)	11:45 a.m.	$8.25

Advance reservations are suggested (SPR-required) and will be processed as they are received based on availability of space. Complete the registration form now.

PLEASE CHECK ACCOMMODATIONS

Single	☐ $41.00
Double Bed (2 persons)	☐ $47.00
Twin Beds (2 persons)	☐ $47.00

SUITES UPON REQUEST

Extra Person - $12 (HI); $14 (JT). No charge for children under 12 sharing parents' room. All rooms subject to city tax. Parking in our in building garage is free to all registered guests

Please note: Reservations must be received by Nov. 12 in order to be confirmed. All reservations received thereafter will be confirmed on availability only.

*Rooms will be held until 6 PM on day of arrival unless accompanied by deposit to cover first night's rental.

Check and mail to preferred hotel

☐ Holiday Inn Golden Gateway or ☐ Jack Tar Hotel
Attn: Reservations Department — Attn: Reservations Manager
1500 Van Ness Avenue — Van Ness at Geary
San Francisco, Ca. 94109 — San Francisco, Ca. 94101
Phone # (415) 441-4000 — Phone # (800) 227-4730

AMERICAN GEOPHYSICAL UNION FALL MEETING
December 7-11, 1981

Arrival Date _____ AM ☐ _____ PM ☐ _____

Departure Date _____ AM ☐ _____ PM ☐ _____

Name _____

Address _____

City _____ State _____ Zip _____

Company Name _____

Additional Name _____

Address _____

City _____ State _____ Zip _____

Company Name _____

Be sure to identify yourself as an AGU attendee when you telephone in your reservations.

AMERICAN GEOPHYSICAL UNION
1981 FALL MEETING

REGISTRATION FORM

Jack Tar Hotel/Holiday Inn-
Golden Gateway Hotel
December 7-11, 1981
San Francisco, California

PLEASE PRINT CLEARLY.

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NAME ON BADGE

AFFILIATION

MAILING ADDRESS

Telephone #

Address during the meeting if different than above

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Meetings Registration
American Geophysical Union
2000 Florida Ave., N.W.
Washington, D.C. 20009

Office Use
Reference Number

Days you plan to attend ☐ Monday ☐ Tuesday ☐ Wednesday ☐ Thursday ☐ Friday

Please check appropriate box
Members of the cooperating societies may register at AGU member rates.
Member badges are blue on white
Nonmember badges are red on white.
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☐ Member cooperating society
AMS-American Meteorological Society
ASP American Society of Photogrammetry
ACSM American Congress on Surveying and Mapping
UGM Union Geofisica Mexicana

DEADLINE FOR RECEIPT OF PREREGISTRATION-
NOVEMBER 17, 1981
(rates applicable only if received by November 17 with payment)

	More than one day	One day
MEMBER	☐ $55	☐ $27.50
STUDENT MEMBER	☐ $25	☐ $12.50
NONMEMBER	☐ $75	☐ $37.50
STUDENT NONMEMBER	☐ $32	☐ $16.00
ABSTRACTS (NOVEMBER 10, *EOS*) $5	☐	

SECTION LUNCHEONS/DINNER
Circle section and indicate number of tickets

Geodesy - Tuesday - $8.00 ☐
Geomagnetism and Paleomagnetism - Thursday - $8.25 ☐
Hydrology - Wednesday - $8.00 ☐
Meteorology - Wednesday - $8.25 ☐
Oceanography - Wednesday - $8.25 ☐
Planetology/Volcanology, Geochemistry, and Petrology - Thursday - $8.25 ☐
Seismology - Tuesday - $3.75 (subsidized) ☐
Solar-Planetary Relationships - Wednesday - $12.00 (subsidized) ☐

Other payments (Please identify) $ _____
Total enclosed $ _____
(All orders must be accompanied by payment or credit card information.)
Make check payable to AGU.

Nonmembers
The difference between member (or student member) registration and nonmember registration may be applied to AGU dues if a completed membership application is received at AGU by February 13, 1982. Current AGU annual membership rates are $20 Members $7 Student Members

Preregistrants
Your receipt will be in your preregistration packet. The registration fee will be refunded if written notice of inability to attend is received in the AGU office by November 17. The program and meeting abstracts will appear in the November 10 issue of *EOS*, which is mailed to all members in advance of the meeting.

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International Laser Radar Conference

A call for papers has been issued for the 11th International Laser Radar Conference, slated for June 21–25, 1982, at the University of Wisconsin at Madison.

The program, to consist of invited and contributed papers, will include discussions on meteorological lidar (light and detection ranging) investigations, including clouds, precipitation, water vapor, temperature, pressure, and winds; studies of the atmosphere, using lidar; lidar investigations of tropospheric chemistry and diffusion; applications of lidar to atmospheric propagation and radiative transfer; and new lidar concepts and applications.

Abstract deadline is February 26. For details on the abstract format and further conference information, contact Jody Edwards, Conference Coordinator, 11th International Laser Radar Conference, Space Science and Engineering Center, 1225 West Dayton Street, Madison, WI 53706 (telephone: 608/263-6780).

The conference, to be held under the auspices of the Committee on Laser Atmospheric Studies (CLAS) of the American Meteorological Society, is sponsored by the Space Science and Engineering Center of the University of Wisconsin at Madison. The Optical Society of America and the Radiation Commission of the International Association of Meteorology and Atmospheric Physics (IAMAP) are cooperating organizations. James A. Weinman, of the Department of Meteorology and the Space Science and Engineering Center, is program chairman. ⊗

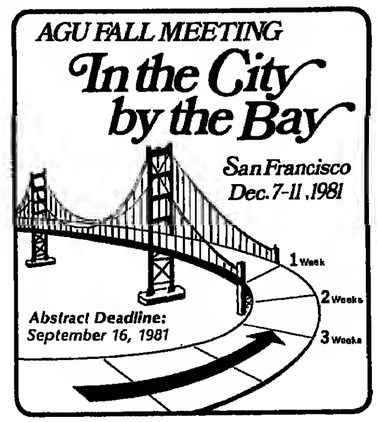
Geological Information Conference

The Second International Conference on Geological Information will be held at the Colorado School of Mines on May 23–27, 1982. Theme of the meeting will be international cooperation to identify and share geological information. Sessions will focus on current activities in national surveys and geoscience information groups; international programs and their prospects for the future; and development of inventories of natural resources information. Several field trips are slated during the conference.

Authors wishing to contribute a paper should send a tentative title by October 1 to D. C. Ward, International Conference on Geological Information, 223 Natural History Building, 1301 West Green St., Urbana, IL 61801. The abstract deadline is November 15.

Correspondence from North America concerning the conference should be addressed to Ward. All others are urged to write to A. P. Hervey, Department of Library Sciences, British Museum (Natural History), Cromwell Road, London SW7 5BD, United Kingdom.

The conference will be sponsored and organized by the Geoscience Information Society and the Geological Information Group of the Geological Society of London together with the International Union of Geological Sciences, Association of Chief Librarians of National Geological Surveys, and the Association of Geoscientists for International Development. H. K. Phinney, Jr., library director at the Colorado School of Mines, is the local committee chairman. ⊗



Geophysical Year

(Boldface indicates meetings sponsored or cosponsored by AGU.)

1981

Aug. 17–28 Third Scientific Assembly of IAMAP with Extraordinary General Assembly, Hamburg, Federal Republic of Germany. (S. Ruttenburg, NCAR, P.O. Box 3000, Boulder, CO 80307.)

Aug. 24–25 International Symposium on Management of Geodetic Data, Copenhagen, Denmark. Sponsors, IAG, the Danish National Committee of IUGG, Geodaetisk Institut. (C. C. Tscherning, International Symposium Management of Geodetic Data, Geodaetisk Institut, Gamleheve Alle 22, Charlottenlund DK-2920 Denmark.)

Aug. 24–29 Eighth Annual Meeting of the European Geophysical Society, Uppsala, Sweden. (C.-E. Lund, Chairman Local Organizing Committee, Institute of Solid Earth Physics, Uppsala University, Box 556, 22 Uppsala, Sweden.)

Aug. 25–27 The Royal Institution of Chartered Surveyors Centenary Celebration, London, England. (Representative Rednaski, American Congress on Surveying and Mapping, 210 Little Falls Street, Falls Church, VA 22046.)

Aug. 28–Sept. 9 Arc Volcanism Symposium, Tokyo, Japan. Sponsors, Volcanological Society of Japan, IAVCEI. (Daisuke Shimozuru, IAVCEI Symposium on Arc Volcanism, Earthquake Research Institute, Univ. of Tokyo, Bunkyo-ku, Tokyo 113 Japan.)

Aug. 31–Sept. 2 Third International Colloquium on Mars, Pasadena, Calif. Sponsors, NASA, Lunar and Planetary Institute, Division of Planetary Sciences of the AAS. (Conway W. Snyder, Jet Propulsion Laboratory, Pasadena, CA 91109.)

Aug. 31–Sept. 5 Symposium on Geodetic Networks and Computations, Munich, West Germany. Sponsor, IAG. (Deutsche Geodätische Kommission, Beyerischen Akademie der Wissenschaften, Marsiallplatz 8, D-8000 Munchen 22.)

Sept. United Nations Symposium on Water Management in Industrialized Areas, Lisbon, Portugal. (Chairman of the Executive Committee, International Symposium on Water Management in Industrial Areas, Portuguese Water Resources Association, c/o LNEC, Av. do Brasil, 101, 1799 Lisbon, Portugal.)

Sept. 7–12 Third International Symposium on Antarctic Glaciology, Columbus, Ohio. Sponsors, International Commission on Snow and Ice, International Glaciological Society. (Institute of Polar Studies, Ohio State Univ., 125 S. Oval Mall, Columbus, OH 43210.)

Sept. 8–12 American Society of Photogrammetry-American Congress on Surveying and Mapping Fall Convention, San Francisco, Calif. (L. W. Aggers, USGS, 345 Middlefield Road, Mail Stop 31, Menlo Park, CA 94025.)

Sept. 9–13 Symposium and Workshop on Applications of Remote Sensing for Rice Production, Hyderabad, India. Sponsors, Institute for Atmospheric Optics and Remote Sensing, National Remote Sensing Agency. (A. Deepak, Institute for Atmospheric Optics and Remote Sensing, P.O. Box P, Hampton, VA 23666.)

Sept. 13–17 National Water Well Association 33rd Annual Convention and Groundwater Technology Education Session, Kansas City, Mo. (NWWA, 500 West Wilson Bridge Rd., Worthington, OH 43085.)

Sept. 16–18 **Oceans '81,** Boston, Mass. Sponsors, Marine Technology Society, IEEE Council of Oceanic Engineering, AGU. (R. Negle, Publicity Manager, Raytheon Company, 141 Spring St., Lexington, MA 02173.)

Sept. 17–18 **Midwest Meeting,** Minneapolis, Minn. (Meetings, AGU, 2000 Florida Ave., N.W., Washington, DC 20009.)

Sept. 17–19 **Pacific Northwest Regional Meeting,** Ellensburg, Wash. (Bob Bentley, PNAGU, Central Washington University, P.O. Box 1000, Department of Geology, Ellensburg, WA 98920.)

Sept. 20–22 National Water Well Association 34th Annual Convention and Exposition, Atlanta, Ga. (NWWA, 500 West Wilson Bridge Rd., Worthington, OH 43085.)

Sept. 28–Oct. 10 NATO Advanced Study Institute on Chemistry of the Unpolluted and Polluted Troposphere, Corfu, Greece. (W. Jaeschke, Center of Environmental Protection, University of Frankfurt, Robert-Meyer-Str. 11, 6000 Frankfurt/Main, FRG.)

Oct. 6–8 International Conference on Time Series Methods in Hydrosciences, Burlington, Ontario. Sponsors, National Water Research Institute of the Canada Centre for Inland Waters and Water-Resources Branch of Ontario's Ministry of Environment. (A. El-Shaarawi, Aquatic Physics and Systems Division, NWRI, Canada Centre for Inland Waters, P.O. Box 5050, Burlington, Ontario L7R 4A6 Canada.)

Oct. 7–9 John Muir Geophysical Society's Fourth Nonannual Meeting, Lake Arrowhead, Calif. (M. McNutt, USGS, Menlo Park, CA 94025.)

Oct. 11–14 Coastal Society's Seventh Annual Conference, Galveston, Tex. (N. West, Coastal Society Conference, Department of Geography and Marine Affairs, Univ. of Rhode Island, Kingston, RI 02881.)

Oct. 11–15 51st Annual International Meeting of the Society of Exploration Geophysicists, Los Angeles, Calif. (William L. Baker, Technical Program Chairman, c/o Chevron Oil Field Research Co., Box 446, La Habra, CA 90631.)

Oct. 12–18 Third International Ocean Disposal Symposium, Woods Hole, Mass. Sponsor, Office of Marine Pollution Assessment, NOAA. (I. W. Duedall, Marine Sciences Research Center, State University of New York, Stony Brook, NY 11794.)

Oct. 13–15 Fifth Geopressured-Geothermal Energy Conference, Baton Rouge, La. Sponsors, Louisiana Geological Survey, Department of Natural Resources; Energy Programs Office, Louisiana State University; U.S. Department of Energy. (Ann Bachman, Conference Coordinator, Energy Programs Office, 105 Hill Memorial, Louisiana State Univ., Baton Rouge, LA 70803.)

Oct. 13–18 Division of Planetary Sciences of the American Astronomical Society Annual Meeting, Pittsburgh, Pa. (B. Hapke, Dept. of Geology and Planetary Science, 321 Old Engineering Hall, University of Pittsburgh, Pittsburgh, PA 15260.)

Oct. 14–16 Third Surveying and Mapping Colloquium for the Petroleum Industry, Banff, Alberta, Canada. Sponsor, Canadian Petroleum Association. (Liz Hampton, Canadian Petroleum Association, 1500, 633 Sixth Ave., S.W., Calgary, Alberta, Canada T2P 2Y5.)

Oct. 19–22 Earth Impact Conference, Snowbird, Utah. Sponsors, Lunar and Planetary Institute, National Academy of Sciences. (Earth Impact Conference, Lunar and Planetary Institute, 3303 NASA Road 1, Houston, TX 77058.)

Oct. 22–24 Fourth Conference on the Physics of the Jovian and Saturnian Magnetospheres, Laurel, Md. Sponsor, NASA. (S. M. Krimigis, Applied Physics Laboratory, Johns Hopkins Univ., Laurel, MD 20810.)

Oct. 28–30 Symposium on Quaternary Land-Sea Migration Bridges and Human Occupation of Submerged Coastlines, La Jolla, Calif. Sponsors, Quaternary Shorelines Commission of the International Union for Quaternary Research, Scientific Committee of the World Confederation of Underwater Activities. (Patricia M. Masters, Scripps Institution of Oceanography, A6-012, La Jolla, CA 92093.)

Oct. 28–30 28th Annual Midwest Groundwater Conference, Bismarck, N. Dak. Sponsors, North Dakota State Water Commission, North Dakota District WRD-USGS, North Dakota Geological Survey, North Dakota WRRI. (O. Ripley, North Dakota State Water Commission, 900 E. Boulevard, Bismarck, ND 58501.)

Oct. 29–31 28th Annual Eastern Pacific Oceanic Conference, Idlewood, Calif. (R. Michael Laurs, EPOC Secretary, Southwest Fisheries Center, NMFS, La Jolla, CA 92037.)

November 1–6 Sixth Biennial International Estuarine Research Conference, Gleneden Beach, Oreg. Sponsor, Estuarine Research Federation. (Jay F. Watson, Treasurer, USFWS Suite 1962, 500 N.E. Multnomah Street, Portland, OR 92232.)

Nov. 2–5 GSA Annual Meeting, Cincinnati, Ohio. (J. M. Lalumpe, Meetings Department, GSA, P.O. Box 9140, Boulder, CO 80301.)

Nov. 2–6 International Conference on the Venus Experiment, San Francisco Bay Area, Calif. Sponsor, NASA. (Dr. Lawrence Colin, Ames Research Center, Moffatt Field, CA 94035.)

Nov. 9–11 Special Conference on the Mechanical Behavior of Salt, University Park, Pa. Sponsor, Rock Mechanics Laboratory, Department of Mineral Engineering, Pennsylvania State University. (H. Reginald Hardy, Jr., Rock Mechanics Laboratory, Room 117, Mineral Sciences Building, Pennsylvania State University, University Park, PA 16802.)

Nov. 9–11 Workshop on Comparisons Between Lunar Breccias and Soils and Their Meteoritic Analogs, Houston, Tex. Sponsor, Lunar and Planetary Institute. (P. Jones, Projects Manager, Lunar and Planetary Institute, 3303 NASA Road 1, Houston, TX 77058.).

Nov. 9–20 Second Symposium on Geodesy in Africa, Nairobi, Kenya. Sponsors, IAG, IUGG Local Committee of Kenya, IUGG Committee on Advice to Developing Countries, African Association of Cartography. (R. Omondi, Survey of Kenya, P.O. Box 30046, Nairobi, Kenya.)

Nov. 30–Dec. 11 43rd Session of the International Statistical Institute, Buenos Aires, Argentina. (Jim R. Wallis, IBM, Research Division, Box 218, Yorktown Heights, NY 10598; or G. S. Watson, Bernoulli Society for Mathematical Statistics and Probability, Department of Statistics, Princeton Univ., Princeton, NJ 08544.)

Dec. 3–5 **Topical Conference on the Processes of Planetary Rifting,** San Francisco, Calif. Sponsor, Lunar and Planetary Institute. (Rift Meeting, Projects Office, Lunar and Planetary Institute, 3303 NASA Road 1, Houston, TX 77058.)

Dec. 7–11 **AGU Fall Meeting,** San Francisco, Calif. (Meetings, AGU, 2000 Florida Ave., N.W., Washington, DC 20009.)

Dec. 16–19 Annual International Meeting of the Working Group on Mediterranean Ophiolites, Florence, Italy. (Luigi Beccaluva, Istituto di Petrografia, Via Gramsci 9, 43100 Parma, Italy.)

1982

Jan. 11–14 Symposium on the Understanding of Hydrologic Processes of the Basin Seals, Caracas, Venezuela. Sponsors, Universidad Simón Bolivar, IAHS. (Ignacio Rodriguez-Iturbe, Universidad Simón Bolivar, Apartado Postal 00.659, Caracas 1001, Venezuela.)

Jan. 13–15 National Radio Science Meeting, Boulder, Colo. Sponsors, U.S. National Committee for the International Union of Radio Science, IEEE. (U.S. National Committee for URSI, National Research Council, 2101 Constitution Avenue, N.W., Washington, DC 20418.)

Jan 24–29 **Conference on Origins of Plasmas and Electric Fields in the Magnetosphere,** Yosemite National Park, Calif. Sponsors, NASA, AGU. (F. T. Berkey, Center for Atmospheric and Space Sciences, Utah State University, UMC 34, Logan, UT 84322.)

Feb. 8–12 **Third International Geodetic Symposium on Satellite Doppler Positioning,** Las Cruces, N. Mex. Sponsors, Defense Mapping Agency, National Ocean Survey, AGU. (Richard Peat, Defense Mapping Agency, Hydrographic/Topographic Center, 6500 Brooks Lane, N.W., Washington, DC 20315.)

Feb. 16–19 **Ocean Sciences: AGU/ASLO (American Society of Limnology and Oceanography) Joint Meeting,** San Antonio, Tex. (Meetings, AGU, 2000 Florida Ave., N.W., Washington, DC 20009.)

Feb. 25–25 13th Annual Meeting of the International Erosion Control Association. Salt Lake City, Utah. (M. McMillen, Erosion Control Consultants, P.O. Box 195, Pinole, CA 94564.)

Mar. 22–26 International Symposium on Hydrothermal Reactions, Yokohama, Japan. Sponsor, Tokyo Institute of Technology. (Shigeyuki Somiya, Research Laboratory of Engineering Materials, Tokyo Institute of Technology, Nagatsuta, Midori, Yokohama, 227 Japan.)

Mar. 24–27 Conference on Earthquake Hazards in the Eastern San Francisco Bay Area, Hayward, Calif. Sponsors, USGS, East Bay Council on Surveying and Mapping, Calif. Div. of Mines and Geol., Woodward-Clyde Consultants, Calif. St. Univ. at Hayward. (Sue Hirschfeld, Dept. of Geological Sciences, California State University, Hayward, CA 94542.)

Apr. 11–16 Penrose Conference on Antarctica, Shenandoah National Park, Va. Sponsor, GSA. (Ian W. D. Dalziel, Lamont-Doherty Geological Observatory, Columbia University, Palisades, NY 10964.)

April 19–21 Cordilleran Section, Geological Society of America and Seismological Society of America Annual Meeting, Anaheim, Calif. (Neil Maloney, Earth Science Department, California State Univ., Fullerton, CA 92634.)

April 27–29 **Chapman Conference on Rainfall Rates,** Urbana, Ill. (Meetings, AGU, 2000 Florida Avenue, N.W., Washington, DC 20009.)

May 3–6 **Chapman Conference on the Discontinuities in Rock: Their Role and Significance in Geologic Processes,** Santa Fe, N. Mex. (Meetings, AGU, 2000 Florida Avenue, N.W., Washington, DC 20009.)

May 3–7 **14th International Liège Colloquium on Ocean Hydrodynamics,** Liège, Belgium. Sponsors IAPSO, Unesco Marine Sciences Division, EGS, Intergovernmental Oceanographic, AGU. (Jacques C. J. Nihoul, University of Liège, Mecanique des Fluides Géophysiques-Environment, B6- Sart Tilman, B-4000 Liège, Belgium.)

May 7–20 General Meeting of IAG, Tokyo, Japan. (I. Nakagawa, Geodetic Institute, Kyoto University, Sakyo-ku, Kyoto 606 Japan.)

May 10–12 Fourth International Conference on Planning and Management of Water Resources for Industrial, Agricultural, and Urban Use, Marseilles, France. Sponsors, Commission Européenne Mediterranéenne

da Planification des Eaux (C.E.M.P.E.), Société des Eaux de Marseille (S.E.M.), the Bureau de Recherches Géologiques et Minières (B.R.G.M.), Centre de Formation Internationale à la Gestion des Ressources en Eau (CEFIGRE), UNESCO, Commission des Communautés Européennes, Association des Hydrogéologues (AIH). (Secrétariat de la Conférence, Société des Eaux de Marseille, 25 rue Edouard Delanglade—13006 Marseille, France.)

May 17–22 International Solar-Terrestrial Physics Symposium, Ottawa, Ontario, Canada. (Professor Liu, University of Illinois, Urbana, IL 61801.)

May 17–June 3 24th Plenary Meeting of COSPAR, Ottawa, Ontario, Canada. (T. W. McGrath, Executive Member, Local Organizing Committee, XXIV COSPAR, Conference Secretariat, National Research Council, Ottawa, Ontario K1A OR6, Canada.)

May 23–28 Eastern Conference on Water and Energy: Technical and Policy Issues, Pittsburgh, Pa. Sponsors, ASCE, League of Women Voters, Council of State Governments. (F. Kilpatrick, USGS National Center, Mail Stop 414, Reston, VA 22092.)

May 23–27 Second International Conference on Geological Information, Golden, Colo. Sponsors, Geoscience Information Society, Geological Information Group of the Geological Society of London, International Union of Geological Sciences, Association of Chief Librarians of National Geological Surveys, Association of Geoscientists for International Development. (D.C. Ward, International Conference on Geological Information, 223 Natural History Building, 1301 West Green Street, Urbana, IL 61801.)

May 24–28 Joint International IEEE/APS Symposium, National Radio Science Meeting, and Nuclear Electromagnetic Pulse Meeting, Albuquerque, N. Mex. Sponsors, IEEE Antennas and Propagation Society, USNC/URSI Commissions, Permanent NEM Committee. (K. F. Casey, The Dikewood Corp., 1613 University Boulevard, N.E., Albuquerque, NM 87102.)

May 25–20 **Symposium on the Composition of Nonurban Troposphere,** Williamsburg, VA. Sponsors, AMS, NASA, AGU. (Jack Fishman, Mail Stop 401-B, NASA Langley Research Center, Hampton, VA 23665.)

May 31–June 4 **AGU Spring Meeting,** Philadelphia, Pa. (Meetings, AGU, 2000 Florida Ave., N.W., Washington, DC 20009.)

June 13–17 International Symposium on Hydrometeorology, Denver, Colo. Sponsor, American Water Resources Association. (A. I. Johnson, Woodward-Clyde Consultants, 2909 West 7th Ave., Denver, CO 80204.)

June 15–18 **International Conference on Rainwater Cistern Systems,** Honolulu, Hawaii. Sponsors, University of Hawaii's Water Resources Research Center, AGU. (Yu-Si Fok, General Conference Chairman, Water Resources Research Center, Univ. of Hawaii, 2540 Dole Street, Honolulu, HI 96822.)

June 21–25 11th International Laser Radar Conference, Madison, Wis. Sponsor, Space Science and Engineering Center of the University of Wisconsin. (J. Edwards, Conference Coordinator, 11th International Laser Radar Conference, Space Science and Engineering Center, 1225 West Dayton Street, Madison, WI 53706.)

June 27–30 Western Conference on Water and Energy: Technical and Policy Issues, Fort Collins, Colo. Sponsors, ASCE, League of Women Voters, Council of State Governments. (D. Molchall, Stone and Webster Engineering Corp., P.O. Box 5400, Denver, CO 00217.)

June 27–July 2 Fifth International Conference on Geochronology, Cosmochronology, and Isotope Geology, Nikko National Park, Japan. (K. Shibata, Geological Survey of Japan, Higashi 1-1-3, Yatabe, Ibaraki 305 Japan.)

July 19–30 Scientific Meeting of IAHS with Extraordinary General Assembly, Exeter, United Kingdom. (John C. Rodda, Department of the Environment, Water Data Unit, Reading Bridge House, Reading RG1 8PS United Kingdom.)

Aug. 2–13 Joint Oceanographic Assembly, Halifax, Nova Scotia, Canada. Sponsor, Scientific Committee on Oceanic Research. (Leo O'Quinn, National Steering Committee for JOA, c/o Canadian Committee on Oceanography, 240 Sparks St., Ottawa, Ontario K1A 0E6 Canada.)

Aug. 2–6 Second International Symposium/Workshop on Solar-Terrestrial Influences on Weather and Climate, Boulder, Colo. Sponsor, Lockheed Palo Alto Research Laboratory. (Billy M. McCormac, Lockheed Palo Alto Research Laboratory, Dept. 52-13/B202, 3251 Hanover Street, Palo Alto, CA 94304.)

Aug. 15–21 Fourth International Symposium on Antarctic Earth Sciences, Ingle Fonn, South Australia, Australia. Sponsors, Australian Academy of Science, Australian Academy of Technological Sciences, International Union of Geological Sciences, Scientific Committee on Antarctic Research, Geological Society of Australia, Inc., Univ. of Adelaide. (J. B. Jago, South Australian Institute of Technology, P.O. Box 1, Ingle Farm, South Australia, Australia 5098.)

Aug. 15–22 International Meeting on Generation of Major Basalt Types, Reykjavik, Iceland. Sponsors, IAVCEI, IAGC. (Basalt Meeting, c/o G. E. Sigvaldason, Nordic Volcanological Institute, 101 Reykjavik, Iceland.)

Aug. 15–22 IAVCEI and IAGC Joint Meeting, Reykjavik, Iceland. (G. E. Sigvaldason, Nordic Volcanological Institute, Univ. of Iceland, Geosciences Building, 101 Reykjavik, Iceland.)

Aug. 16–18 International Conference on Coal-Fired Power Plants and the Aquatic Environment, Copenhagen, Denmark. Sponsors, International Association on Water Pollution Research, the International Union of Pure and Applied Chemistry, Nordic Cooperative Organization for Applied Research. (DIs Congress Service, Linde Allé 48, DK-2720 Copenhagen, Denmark.)

Aug. 22–28 11th International Congress on Sedimentology, Hamilton, Ontario, Canada. Sponsor, IAS. (IAS Congress 1982, Department of Geology, McMaster University, Hamilton, Ontario L8S 4M1, Canada.)

Aug. 22–28 **Third Circum-Pacific Energy and Mineral Resources Conference,** Honolulu, Hawaii. Sponsor, IUGS. (AAPG Convention Department, P.O. Box 979, Tulsa, OK 74101.)

Aug. 23–27 Second Symposium on Applied Glaciology, Hanover, N.H. Sponsor, International Glaciology Society. (Secretary General, International Glaciological Society, Lensfield Road, Cambridge CB2 1ER, United Kingdom.)

Aug. 24–27 Ninth Annual Meeting of the European Geophysical Society, Leeds, United Kingdom. (J. C. Briden, Department of Earth Sciences, University of Leeds, Leeds LS2 9JT, England.)

Aug. 25–27 23rd U.S. Symposium on Rock Mechanics, Berkeley, Calif. Sponsors, U.S. National Committee for Rock Mechanics, International Society for Rock Mechanics, University of California. (Organizing Committee, 23rd Rock Mechanics Symposium, c/o Richard E. Goodman, Department of Civil Engineering, 440 Davis Hall, University of California, Berkeley, CA 94720.)

Sept. 3–11 Fourth World Congress on Water Resources, Buenos Aires, Argentina. Sponsor, International Water Resources Association. (G. E. Stout, President of the U.S. Geographical Committee, Water Resources Center, University of Illinois, 2535 Hydrosystems Laboratory, 208 N. Romine, Urbana, IL 61801.)

Sept. Third International Kimberlite Conference, Clermont-Ferrand, France. (Francoise Boudier, Université de Nantes, Laboratoire de Tectonophysique, 2 Rue de la Houssinière, 44072 Nantes, France.)

May or Sept. Scientific Meeting of IAPSO, Halifax, Canada. (E. C. LaFond, LaFond Oceanic Consultants, P.O. Box 7325, San Diego, CA 92017.)

Oct. 4–9 International Symposium on Polders of the World, Agore, Lelystad, The Netherlands. Sponsors, Department of Civil Engineering of the Delft University of Technology, Commission on Hydrological Research of the Netherlands Organization of Applied Scientific Research, the IJsselmeerpolders Development Authority, Society for Waterworks and Land Use Planning. (I. H. Wijkel, Information Centre 'New Land,' Oostvaardersdijk 01-13, 8242 PA Lelystad, the Netherlands.)

Oct. 18–21 GSA Annual Meeting, New Orleans, La. (J. M. Lalulippe, Meetings Department, GSA, P.O. Box 9140, Boulder, CO 80301.)

Dec. 6–10 **AGU Fall Meeting,** San Francisco, Calif. (Meetings, AGU, 2000 Florida Ave., N.W., Washington, DC 20009.)

1983

Feb. 1–11 15th Pacific Science Congress, Dunedin, New Zealand. Sponsor, University of Otago. (Secretary-General, P.O. Box 6063, Dunedin, New Zealand.)

June 13–15 **International Symposium on Gas Transfer at Water Surfaces,** Ithaca, N.Y. Sponsors, Cornell University, AGU. (W. H. Brutsaert, School of Civil and Environmental Engineering, Cornell University, Hollister Hall, Ithaca, NY 14853.)

July 18–23 Fourth International Conference on Permafrost, Fairbanks, Alaska. Sponsors, National Academy of Sciences, State of Alaska. (L. Da Goes, Polar Research Board, National Academy of Sciences, 2101 Constitution Ave., N.W., Washington, DC 20418.)

Aug. 15–28 18th General Assembly of IUGG, Hamburg, Federal Republic of Germany. (P. Melchior, Observatoire Royal de Belgique, Avenue Circulaire 3, B-1180 Bruxelles, Belgium.)

Aug. 27 Symposium Commemorating the 100th Anniversary of the Mount Krakatau Eruption, Jakarta, Indonesia. Sponsor, Indonesian Institute of Sciences. (Didin Sastrapradja, Deputy Chairman for Natural Sciences, L1P1 JL, Teuku Chik Ditiro 43, Jakarta, Indonesia.)

Sept. 12–14 National Water Well Association 35th Annual Convention and Exposition, St. Louis, Mo. (NWWA, 500 West Wilson Bridge Rd., Worthington, OH 43085.)

Oct. 31–Nov. 3 GSA Annual Meeting, Indianapolis, Ind. (J. M. Lalulippe, Meetings Department, GSA, P.O. Box 9140, Boulder, CO 80301.)

Dec. 5–9 **AGU Fall Meeting,** San Francisco, Calif. (Meetings, AGU, 2000 Florida Ave., N.W., Washington, DC 20009.)

1984

July 21–28 Eighth World Conference on Earthquake Engineering, San Francisco, Calif. Sponsor, Earthquake Engineering Research Institute. (R. B. Matthiesen, Chair-BWCEE, EERI, 2620 Telegraph Avenue, Berkeley, CA 94704.)

FUTURE AGU MEETINGS

Fall Meetings
December 7–11, 1981, San Francisco
December 6–10, 1982, San Francisco
December 5–9, 1983, San Francisco

Spring Meetings
May 31–June 4, 1982, Philadelphia

AAPG American Association of Petroleum Geologists
AMS American Meteorological Society
ASCE American Society of Chemical Engineers
GSA Geological Society of America
IAG International Association of Geodesy
IAGA International Association of Geomagnetism and Aeronomy
IAHS International Association for Hydrological Sciences
IAMAP International Association of Meteorology and Atmospheric Physics
IAPSO International Association of Physical Sciences of the Ocean
IASPEI International Association of Seismology and Physics of the Earth's Interior
IAVCEI International Association of Volcanology and Chemistry of the Earth's Interior
IUGS International Union of Geological Sciences
IWRA International Water Resources Association
MSA Mineralogical Society of America
SEG Society of Exploration Geophysicists
SEPM Society of Economic Paleontologists and Mineralogists
URSI International Union of Radio Science

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Hydrology

3150 Precipitation
A SIMPLE METHOD FOR ESTIMATING CONVECTIVE RAIN VOLUME OVER AN AREA
A. A. Doneaud (Institute of Atmospheric Sciences, South Dakota School of Mines and Technology, Rapid City, South Dakota 57701), P. L. Smith, A. S. Dennis, and S. Sengupta
Previous authors have reported significant correlations between the horizontal extent of convective showers or storms and the volume of rain they produce. This paper employs that idea to develop a simplified method for estimating convective rainfall by considering only the horizontal extent and duration of the precipitation.
The present analysis is based on rain gage and radar data from an area in western North Dakota. A synoptic adjustment is applied to the radar rain volume estimates. A quantity called the Integrated Rainfall Coverage can be calculated from either gage or radar data and is found to be well correlated with the rain volumes. The maximum echo area during any one scan in one hour seems to be the locally radar measurement best correlated with the rain volumes. This limited study suggests that the accuracy of the simplified method approaches that of methods using radar reflectivity data and may have operational value in some special situations. (Radar, precipitation, convection).
Water Resour. Res., Paper 1W1197

3110 Snow and Ice
PROPERTIES OF BLOWING SNOW
R. A. Schmidt (USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, 240 W. Prospect, Fort Collins, Colorado 80526)
Size and shape of windblown snow particles determine not only mass transported by turbulent fluxes, but also the rate of phase change from ice to water vapor that occurs in this multiphase flow. These properties and particle densities dictate particle fall velocity, and therefore, the vertical distribution of mass and surface area, which strongly influence the gradients and fluxes of sensible heat and water vapor within the transport layer.
Initial movement at the snow surface depends more on availability and impact forces of loose particles than on aerodynamic drag. Cohesion between surface particles and particle restitution coefficient are important properties that determine threshold wind speeds for snow transport.
Threshold speeds for blowing snow vary over such a large range in nature, that formulations predicting transport rate as a function of windspeed should include threshold speed as a parameter. The expression derived by Iversen et al. [1975] is compared with low-level snow transport in the atmospheric boundary layer.
Self-similarity of wind profiles in blowing snow is a property of the flow that has been exploited for scale modeling of snow deposition around obstacles, both outdoors and in wind tunnels. Good quantitative results are obtained by careful attention to similitude requirements. (Blowing snow, snowdrift, turbulent boundary layer).
Rev. Geophys. Space Phys., Paper 1R1191

3110 Snow and Ice
A SIMULATION OF THE ENRICHMENT OF ATMOSPHERIC POLLUTANTS IN SNOW COVER RUNOFF
S.C. Colbeck (U.S. Army Cold Regions Research and Engineering Laboratory, Hanover, NH 03755)
The soluble impurities contained in a snow cover can be concentrated as much as five fold in the first fractions of snowmelt runoff. In addition, daily impurity surges are possible. Melt-freeze cycles concentrate the impurities in the lower portion of the snow cover hence prepare the impurities for rapid removal. Environmental damage can occur due to the concentration and rapid release of atmospheric pollutants from the snow, especially in areas of "acid precipitation." The enrichment of the soluble impurities is explained and the results of laboratory experiments are given. (Snow cover, acid runoff, atmospheric pollutants).
Water Resour. Res., Paper 1W1157

3199 General or Miscellaneous
DATA REQUIREMENTS FOR KRIGING: ESTIMATION AND NETWORK DESIGN
J.P. Hughes and D.P. Lettenmaier (Department of Civil Engineering FX-10, University of Washington, Seattle, WA 98195)
Kriging, a technique for interpolating nonstationary spatial phenomena, has recently been applied to such diverse hydrologic problems as interpolation of piezometric heads and transmissivities estimated from hydrogeologic surveys and estimation of mean areal precipitation accumulations. An important concern for users of this technique is the effect of sample size on the precision of estimates obtained. Comparisons made between conventional least squares and kriging estimators indicate that for samples of size less than approximately 30, kriging offered no clear advantage over least squares in a Bayesian sense although kriging may be preferable from the Bayesian viewpoint. A network design algorithm was also developed. Tests performed using the algorithm indicated that the information content of identified networks was relatively insensitive to the size of the pilot network. These results suggest that within the range of sample sizes typically of hydrologic interest, kriging may hold more potential for network design than for data analysis. (Kriging, network design, spatial estimation).
Water Resour. Res., Paper 1W1190

Meteorology

3710 Boundary-layer structures and processes
TURBULENT TRANSPORT OF ELECTRIC CHARGE IN THE MARINE ATMOSPHERIC BOUNDARY-LAYER
Ralph Markson (Airborne Research Associates, 46 Kendal Common Road, Weston, MA 02193) Jan Sedláček and Christopher W. Fairall
Sensible heat, water vapor, aerosols, gaseous pollutants and electric charge are transported vertically in the marine boundary-layer by turbulent processes. The standard eddy correlation method of measuring fluxes from aircraft require inertial navigation systems, considerable computer power and large aircraft with gust probes on specially engineered booms to correct for aircraft motions. Only a few laboratories can afford to operate aircraft systems of the required complexity. The development of a method for obtaining routine, high quality, relatively inexpensive measurements of at least one boundary-layer flux profile from light aircraft (specifically not requiring an inertial platform or angular motion data) could permit enhancement of boundary-layer research on a new statistical scale. The flux of electric charge (called the eddy current) can be inferred from simple measurements of electric field intensity and conductivity from a light aircraft. Recent aircraft measurements off the California coast show good correlation of surface layer eddy current peak values with the surface water vapor flux and the convective mixed layer velocity, W_*. The electrical technique also appears to have exceptional sensitivity exceeding that of the eddy correlation technique. It is suggested that the eddy current could be used to infer the flux profiles of other passive scalars.
Because space charge undergoes a decay in time, the space charge density does not tend to be well mixed (constant with altitude) in the planetary boundary-layer. The ease of measuring space charge density gradient allows accurate determination of the passive scalar eddy diffusion coefficient, K, a parameter that has been difficult to measure in the past. Thus, atmospheric electrical measurements from aircraft have the potential for providing important new information for pollution modeling and studies of boundary-layer meteorology.
J. Geophys. Res., Green, Paper 1C1096

3735 Electrical phenomena
LIGHTNING AMPLITUDE SPECTRA IN THE INTERVAL FROM 100 kHz TO 20 MHz
C. D. Weidman, E. P. Krider (Institute of Atmospheric Physics, University of Arizona, Tucson, Arizona 85721, U.S.A.), and M. A. Uman
The electric radiation fields produced by lightning return strokes, stepped leaders, and intracloud discharge processes have been Fourier-analyzed to determine amplitude spectra for these processes from about 100 kHz to 20 MHz. The fields were recorded under conditions where the lightning locations were known and where the field propagation from the lightning sources to the recording site was entirely over salt water. The spectra for return strokes show an f^{-1} frequency dependence from 100 kHz to 2 MHz, an f^{-2} dependence between 2 and 10 MHz, and an f^{-5} decrease above 10 MHz. In the 1 to 20 MHz range, the spectra of the initial fast transition in return strokes, the initial fast-rising portion of leader steps, and the fast transitions in positive intracloud pulses are surprisingly similar. (lightning, thunderstorms, electromagnetic interference).
Geophys. Res. Lett., Paper 1L1077

3750 H_2O in the atmosphere (humidity, clouds, and precipitation)
CARBON DIOXIDE AND CLIMATE: THE EFFECTS OF WATER TRANSPORT IN RADIATIVE-CONVECTIVE MODELS
J. R. Hummel (General Motors Research Laboratories, Physics Department, Warren, Michigan 48090-9055) R. A. Reck
Considerable attention is being focused on the possible climatic effects resulting from increases in the concentration of atmospheric carbon dioxide. In calculating CO_2 influence on the thermal structure of the atmosphere, the role of clouds is critically important. Not only are the cloud properties, such as amount, numbers of clouds, altitudes, and optical properties important but also whether or not these properties are fixed or coupled to model temperatures. The transport of water vapor determines whether or not a region has clouds, the cloud properties, and the water vapor profiles appropriate for clear and cloudy skies.
Results are presented of the change in surface temperature with changes in carbon dioxide content for two radiative-convective models with three different cloud coverages. We used (1) the Manabe-Wetherald radiative-convective model in which three clouds with fixed pressures, thicknesses, and optical properties and a single water vapor profile are inputed and (2) the Hummel-Kuhn model which couples radiative heating, convection, and water vapor transport in order to calculate locations and thicknesses, and a radiative-convective equilibrium temperature profile.
The Hummel-Kuhn model yields surface temperature increases for doubled CO_2 larger than the Manabe-Wetherald model for various assumed total cloud cover amounts. For assumed standard cloud cover amounts the Hummel-Kuhn estimate is 20% larger than the Manabe-Wetherald estimate. For reduced and enhanced cloud cover amounts the Hummel-Kuhn estimates are 37% and 17% larger, respectively. The calculated cloud locations and thicknesses did not change in the calculations, therefore the increased sensitivity in the Hummel-Kuhn model is due to the larger water vapor amounts in the Hummel-Kuhn model and the added infrared absorption by the water vapor layer.
J. Geophys. Res., Green, Paper 1C1257

3770 Particles and Aerosols
DETERMINATION OF VERTICAL PROFILES OF AEROSOL SIZE SPECTRA FROM AIRCRAFT RADIATIVE FLUX MEASUREMENTS PART II. THE EFFECT OF PARTICLE NONSPHERICITY
R. Welch, (Institut fur Meteorologie, Johannes Gutenberg University, Mainz, Germany), S. Cox (Department of Atmospheric Science, Colorado State University) and K. Ya. Kondratyev (Main Geophysical Observatory, Leningrad, U.S.S.R.)
The effect of particle nonsphericity upon the retrieval of particle size distributions, computed from aircraft radiative flux measurements, has been examined for the data of 4 September 1974. The particle inversion procedure is identical to that described by Kondratyev et al. (1981), involving quadramodal particle size spectra. Nonspherical particle attenuation coefficients and phase functions were calculated according to the semi-empirical approach developed by Pollack and Cuzzi.
It was found that variations of the phase function by nonspherical particles affected the retrieval of particle size spectra to a far greater degree than did variations of particle scattering efficiency. Nonspherical particles generally have smaller values of asymmetry factor than do their spherical counterparts. The inferred size spectra of nonspherical particles show decreased values both of large and small particle number densities along with a broadening of the large particle mode to include particles of larger sizes.
J. Geophys. Res., Green, Paper 1C1151

3770 Particles and Aerosols
DETERMINATION OF VERTICAL PROFILES OF AEROSOL SIZE SPECTRA FROM AIRCRAFT RADIATIVE FLUX MEASUREMENTS PART II. THE EFFECT OF PARTICLE NONSPHERICITY
R. Welch, (Institut fur Meteorologie, Johannes Gutenberg University, Mainz, Germany), S. Cox (Department of Atmospheric Science, Colorado State University) and K. Ya. Kondratyev (Main Geophysical Observatory, Leningrad, U.S.S.R.)
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J. Geophys. Res., Green, Paper 1C1154

3770 Particles and aerosols
DETERMINATION OF VERTICAL PROFILES OF AEROSOL SIZE SPECTRA FROM AIRCRAFT RADIATIVE FLUX MEASUREMENTS. PART I. RETRIEVAL OF SPHERICAL PARTICLE SIZE DISTRIBUTIONS
K. Ya. Kondratyev, M. Prokofyev, V. Ivanov, V. Zhvalev (Main Geophysical Observatory, Leningrad, U.S.S.R.), S. Cox (Department of Atmospheric Science, Colorado State University), R. Welch (Institut fur Meteorologie, Johannes Gutenberg University, Mainz, Germany), O. Vasilyev, V. Radionov and L. Ivlev (Department of Physics, Leningrad State University, Leningrad, U.S.S.R.)
During the GATE observational program, aircraft radiative flux measurements were taken at several altitudes in the Saharan dust. On the basis of these flux measurements at 26 wavelengths in the 0.4 – 0.9 µm wavelength region, the corresponding vertical particle size spectra have been inferred. These particle size distributions, calculated using spherical Mie theory, have been represented by quadramodal combinations of gamma functions. The calculated quadramodal size distributions were characterized by mode radii at 0.1, 0.2, 1.0 and 2.0 µm, with a relatively narrow spread of particle sizes centered about each mode radius.
The number density of the smallest particle mode was found to increase with increasing height, while that of the largest particle mode decreased with increasing height. Comparison of deduced particle sizes of a 'dusty' day (4 September) and a 'clear' day (13 August) showed that the dusty day was characterized far more by the presence of large particles than by an increase in small particle concentration. Heating rates as large as 0.4°C/hour-µm were found for 4 September 1974.
J. Geophys. Res., Green, Paper 1C1153

Mineralogy, Petrology, and Crystal Chemistry

4240 Isotope mineralogy
POSSIBLE ISOTOPIC FRACTIONATION EFFECTS IN MATERIAL SPUTTERED FROM MINERALS
P. K. Haff (W. K. Kellogg Radiation Laboratory, Caltech, Pasadena, CA 91125) C. C. Watson and T. A. Tombrello
We discuss in detail a model which makes definite predictions for the fractionation of isotopes in sputtered material. The fractionation patterns can be non-linear, and the pattern for a particular set of isotopes depends on the chemical matrix within which those isotopes are contained. Calculations are presented for all non-monoisotopic elements contained in the minerals perovskite, anorthite, akermanite, enstatite, and troilite. All isotopes are fractionated at the level of approximately 4-8 ‰ per atomic mass unit. O is always positively fractionated (heavier isotopes sputtered preferentially), and heavier elements are generally negatively fractionated (lighter isotopes sputtered preferentially). The value of $\delta(^{18}O:^{16}O)$ is always less by about 1.8 ‰ than a linear extrapolation based upon the calculated $\delta(^{17}O:^{16}O)$ value would suggest. The phenomenon of both negative and positive fractionation patterns from a single target mineral can be used to make an experimental test of the proposed model.
J. Geophys. Res., Red, 1B0962

4260 Paragenesis, petrography, and petrogenesis
MINOR- AND TRACE-ELEMENT GEOCHEMISTRY OF VOLCANIC ROCKS DREDGED FROM THE GALAPAGOS SPREADING CENTER: ROLE OF CRYSTAL FRACTIONATION AND MANTLE HETEROGENEITY
D. A. Clague (U.S. Geological Survey, 345 Middlefield Road, Menlo Park, CA 94025) F. A. Frey, G. Thompson and S. Rindge
A wide range of rock types (abyssal tholeiite, Fe-Ti-rich basalt, andesite, and rhyodacite) were dredged from near 95°W and 85°W on the Galapagos spreading center. Computer modeling of major-element compositions has shown that these rocks could be derived from common parental magmas by successive degrees of fractional crystallization. However, the P_2O_5/K_2O ratio averages 0.71 at 95°W and 1.88 at 85°W and implies distinct mantle source compositions for the two areas. These source regions also have different rare-earth-element (REE) abundance patterns, with $(La/Sm)_{EF}$ = 0.67 at 95°W and 0.46 at 85°W. The sequence of fractionated lavas differs for the two areas and indicates earlier fractionation of apatite and titanomagnetite in the lavas from 95°W. The mantle source regions for these two areas are interpreted to be depleted in incompatible (and volatile?) elements, although the source region beneath 95°W is less severely depleted in La and P.
Incompatible trace element abundances in 76 samples are used to infer that the range of Fe-Ti-rich basalt from 85°W represents 19 to 55 residual liquid following crystal fractionation of a mineral assemblage of plagioclase, clinopyroxene, and lesser olivine. The most highly differentiated samples have also had less than 1% titanomagnetite removed. Most of the samples from 85°W can be related to a common parental magma that contained approximately 9 wt% FeO*, 1 wt% TiO_2, and had an Mg number ($Mg/(Mg+Fe^{2+})$) of about 65. Although the samples from 95°W cannot all be derived from a common parental magma, the inferred parental magmas may have been derived by varying degrees of partial melting of a common source. The fractionation sequence consists of two parts: an initial iron enrichment trend followed by a silica enrichment trend. We interpret the trace-element data to indicate that the most iron rich lavas represent about 22% residual liquid derived by crystal fractionation of plagioclase, clinopyroxene, and lesser olivine from a parental magma with an Mg number of about 60. The silica-enrichment trend results from crystallization of titanomagnetite and some apatite. Fractionation of pigeonite, which is a minor phase is the major element models, cannot be distinguished from clinopyroxene fractionation using trace elements.
J. Geophys. Res., Red, Paper 1B1110

Particles and Fields—Interplanetary Space

5140 Shock Waves
STEEPENING, SOLITON AND LANDAU DAMPING OF LARGE-AMPLITUDE MAGNETOSONIC WAVES --- PARTICLE CODE COMPUTER SIMULATION ---
H. Matsumoto (Radio Atmospheric Science Center, Kyoto University, Uji bll, Japan) R. Nagai
In order to understand and interpret the large-amplitude hydromagnetic fluctuations in the solar wind plasma, a particle code computer simulation is carried out for a study of nonlinear characteristics of large-amplitude magnetosonic waves in a magnetized high β plasma. Not only magnetohydrodynamic (MHD) features such as steepening, shock formation and soliton production, but also kinetic effect such as Landau damping are observed. The time evolution of a large-amplitude magnetosonic wave is: It first exhibits steepening because of nonlinear propagation characteristics and show a forward tilting of its magnetic field profile. Comparison with an existing nonlinear kinetic theory for the nonlinear propagation velocity and the steepening time shows a good agreement between the theory and the simulation up to a time of shock formation. The measured Landau damping rate in the simulation agrees well with the linear kinetic theory even for large-amplitude magnetosonic waves. This is the case when the steepening time is much shorter than the particle trapping time. After a shock condition is reached, solitary spikes are observed from the vicinity of the wave peak which eventually changes the feature of the steepening. The final wave form within the present computation shows a backward tilting of its magnetic field component. (magnetosonic wave, steepening, soliton, Landau damping).
J. Geophys. Res., Blue, Paper 1A1182

5160 Solar wind interactions with moon and planets
THE SOLAR WIND INTERACTION WITH MARS RE-VISITED
J.A. Slavin (Institute of Geophysics and Planetary Physics, University of California, Los Angeles, CA 90024) and R.E. Holzer
Due to a paucity of observational data, no clear consensus has been reached concerning the general nature of the solar wind interaction with Mars. In particular, the previous analyses are still at odds regarding the existence of a small intrinsic field magnetosphere at Mars as opposed to a Venus-type ionospheric interaction (e.g. Russell, 1978a,b; Dolginov, 1978b,c). This study contributes to the resolution of this question in three ways. First, an improved determination of effective obstacle altitude and shape is obtained from the Mars 2, 3, and 5 bow shock encounters through the use of a recently published catalog of gasdynamic flow solutions (Spreiter and Stahara, 1980a,b). Secondly, building upon the Pioneer Venus findings at a field-free planet (Grace et al., 1980; Elphic et al., 1980), it is shown that the Martian ionosphere cannot support a Venus-type ionopause at the obstacle altitudes inferred through our modeling of the bow wave observations even when maximal induced ionospheric magnetic fields and solar maximum EUV levels are assumed. These results allow an effective Mars magnetic dipole moment of 1.4 (±0.6) × 10^{22} G-cm³ to be determined which stands off the solar wind over the dayside hemisphere at altitudes ranging from ∿ 500 at the subsolar point to ∿ 1000 km near the terminator with no direct aid from the ionosphere under average solar wind/magnetospheric conditions. Thirdly, a search of published Mars and Mariner radio occultation measurements produced no evidence for the existence of an ionopause at Mars in agreement with the Viking study of Lindal et al. (1979). Rather, the electron density altitude profiles appear qualitatively consistent with the Martian ionosphere terminating in a chemopause associated with the effects of magnetospheric convection as first proposed by Bauer and Hartle (1973). After a review of the various arguments in the literature, as supplemented by the results of this study, we conclude that Mars most probably possesses a small intrinsic field magnetosphere.
J. Geophys. Res., Blue, Paper 1A1202

5160 Solar wind interactions with moon and planets
THE SOLAR WIND INTERACTION WITH MARS RE-VISITED
J.A. Slavin (Institute of Geophysics and Planetary Physics, University of California, Los Angeles, CA 90024) and R.E. Holzer
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J. Geophys. Res., Blue, Paper 1A1202

Particles and Fields—Ionosphere

5520 Electric fields
MEASUREMENT OF MIDDLE-ATMOSPHERE ELECTRIC FIELDS AND ASSOCIATED ELECTRICAL CONDUCTIVITIES
L.C. Hale (Ionosphere Research Laboratory, Electrical Engineering Department, The Pennsylvania State University, University Park, PA 16802)
C.L. Croskey and J.D. Mitchell
A simple antenna for measuring the vertical electric field in the "middle atmosphere" has been flown on a number of rocket-launched parachute-borne payloads. We present here the data from the first nine such flights, launched under a variety of geophysical conditions, along with electrical conductivities measured simultaneously. The data include indications of layered peaks of several volts per meter in the mesospheric field at high and low latitudes in situations of relatively low conductivity. During an auroral "REP" event the electric field reversed direction in the lower stratosphere, accompanied by a substantial enhancement in conductivity. The data generally do not confirm speculations based only on the extension of the thunderstorm circuit from below or the mapping of ionospheric and magnetospheric fields from above, but seem to require, in addition, internal generation processes in the middle atmosphere.
Geophys. Res. Lett., Paper 1L0231

5561 High-latitude ionospheric currents
GENERATION OF ELF AND VLF WAVES BY POLAR ELECTROJET MODULATION: EXPERIMENTAL RESULTS
P. Stubbe, H. Kopka (Max-Planck-Institut für Aeronomie, 3411 Katlenburg-Lindau 3, Germany) and R.L. Dowden (University of Otago, Dunedin, New Zealand)
The Heating facility at Ramfjordmoen near Tromsø, Norway, has been used to modulate the polar electrojet at frequencies in the range 200 to 5000 Hz. ELF-VLF signals were received on the ground in the full frequency range, with amplitudes of the order 10 to 100 fT for an effective radiated power of 12 MW at 4.04 MHz. A variety of experimental results is presented in this paper.
J. Geophys. Res., Blue, Paper 1A0740

5571 Ionospheric Disturbances
DOMINANT CONFIGURATIONS OF SCINTILLATION-PRODUCING IRREGULARITIES IN THE AURORAL ZONE
E.J. Fremouw and J.M. Lansinger (Physical Dynamics, Inc., Bellevue, WA, 98009, USA)
Scintillation observations in recent years have disclosed sheetlike plasma-density irregularities aligned along L shells in the auroral-zone ionosphere. Such irregularities produce a line of enhanced scintillation across the sky as observed from a single observing station, the enhancement coinciding with the intersection of the station's L shell and the scattering layer. We have exploited this aspect sensitivity to identify time and latitude regimes in which the dominant configuration of F-layer irregularities observable from a station in the classical auroral zone is either sheetlike or rodlike (showing axial symmetry about the magnetic field). Employing measurements of VHF phase and amplitude scintillation obtained at Poker Flat, Alaska (L ≈ 5.5) from 1043 passes of the DNA Wideband satellite, we find evidence for sheetlike structures only on the night side of the earth poleward of the high-latitude scintillation boundary (Aarons et al, 1969). Scintillation is sometimes detected equatorward of the nightside boundary, and it is attributable to fairly irregularities in the main trough. We observed geometrical enhancement in this region only within about ten degrees of the magnetic zenith, which is the signature of axially symmetric irregularities. The same behavior was found equatorward of the dayside scintillation boundary. Careful inspection of the data base also disclosed 95 daytime passes in which the boundary lay sufficiently equatorward of the station that the configuration of irregularities in the dayside high latitude scintillation region could be identified. Geometrical enhancements were observed near the magnetic zenith. Of the 88 passes that did not come within about ten degrees of the magnetic zenith, however, only five revealed enhancements that might convincingly be attributed to sheets. We conclude that sheetlike structure is the dominant configuration of scintillation-producing irregularities in the auroral zone only poleward of the high-latitude scintillation boundary on the night side of the earth. Axial symmetry is the norm elsewhere. (Scintillation, ionospheric irregularities).
J. Geophys. Res., Blue, Paper 1A1140

5560 Particle precipitation
DECAY OF FAST ION STRUCTURE IN THE IONOSPHERE
S. R. Goldman and J. L. Sperling (JAYCOR, San Diego, California, 92138)
Both proton auroral and downward flowing ion events have significant fast ion components. For these phenomena we demonstrate that charge exchange and collisional ionization processes can exert a strong effect on the imaging of ionized density structure in the lower ionosphere. This has value in relating ionized density spectral measurements at altitudes of the F region maximum and below to plasma behavior at higher altitudes, as well as providing initial conditions for locally driven plasma instabilities. It is shown that charge exchange of fast ions into fast neutrals results in the rapid attenuation of structure with neutral mean free paths much larger than the structure dimensions and the generation of structure of larger size. For structure with dimensions much larger than the neutral mean free path, fast neutral loss is diffusive rather than convective and attenuation of structure is less rapid.
J. Geophys. Res., Blue, Paper 1A1201

5560 Wave propagation
AUTOMATIC CALCULATION OF ELECTRON DENSITY PROFILES FROM DIGITAL IONOGRAMS. PART 3. AUTOMATIC O AND X TRACE IDENTIFICATION FOR TOPSIDE IONOGRAMS
Bodo W. Reinisch (University of Lowell Center for Atmospheric Research, 450 Aiken Street, Lowell, MA 01854) and Huang Xueqin
This final paper, in a series of three describing the automatic processing of digital ionograms, discusses the scaling of topside ionograms in a ground based minicomputer. The objective is to automatically obtain the vertical electron density profiles. The Topside Ionogram Scaling Algorithm (TISA) finds the resonances and cut-off frequencies, and the vertical O and X echo traces. Application of TISA to digitized ISIS 1 and 2 ionograms illustrates its performance and demonstrates the feasibility to automatically scale topside ionograms. The ISIS studies show that polarization tagging of the O and X signals should be done in a digital satellite sounder to ensure successful, real time scaling of complex ionograms. (Digital ionograms, topside sounding, automatic scaling).
Rad. Sci., Paper 1S1264

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whose amplitude is of the order of one percent of the background ion flux, are the result of a spacecraft interaction with the ionospheric plasma. A mechanism for producing this interaction that utilizes a fast beam of ambient ions reflected upstream from the satellite to produce a two-stream instability is examined in more detail.

J. Geophys. Res., Blue, Paper 1A1164

Particles and Fields—Magnetosphere

5705 Bow shock waves
SOLAR WIND FLOW ABOUT THE TERRESTRIAL PLANETS 1. MODELING BOW SHOCK POSITION AND SHAPE
J.A. Slavin (Institute of Geophysics and Planetary Physics, University of California, Los Angeles, CA 90024) and E.J. Smith

General techniques for modeling the position and shape of planetary bow waves are reviewed. A three parameter method was selected to model the near portion (i.e. e' > -1 X_{ob}) of the Venus, earth, and Mars bow shocks and the results compared with existing models using 1 to 4 free variables. By limiting consideration to the forward part of the bow wave only the region of the shock surface which is most sensitive to obstacle shape and size was examined. In contrast, most other studies include portions of the more distant downstream shock thus tending to reduce the planetary magnetosphere to question to a point source and constrain the resultant model surfaces to be paraboloid or hyperboloid in shape to avoid downstream closure. It was found by this investigation that the relative effective shapes of the near Martian, Cytherean, and terrestrial bow shocks are ellipsoidal, paraboloidal, and hyperboloidal, respectively, in response to the increasing bluntness of the obstacles that Mars, Venus, and earth present to the solar wind. The position of the terrestrial shock over the years 1959 to 1971 showed only a weak dependence on the phase of the solar cycle after the effects of solar wind dynamic pressure on magnetopause location were taken into account. However, the bow wave of Venus was considerably more distant around solar maximum in 1979 than at minimum in 1975-6 suggesting a solar cycle variation in its interaction with the solar wind. Finally, no significant deviations from axial symmetry were found when the near bow waves of the earth and Venus were mapped into the aberrated terminator plane. This finding is in agreement with the predictions of gasdynamic theory which neglects the effects of the IMF on the grounds of their smallness. Farther downstream where the bow wave position is being limited by the MHD fast mode Mach cone, an elliptical cross section is expected and cited in the results of other investigations.

J. Geophys. Res., Blue, Paper 1A1187

5715 Electric Fields
ON THE STRUCTURES AND MAPPING OF AURORAL ELECTROSTATIC POTENTIALS
Y. T. Chiu (Space Sciences Laboratory, The Aerospace Corporation, El Segundo, CA 90245), A. L. Newman and J. M. Cornwall

We examine the mapping of magnetospheric [illegible]

[illegible]

5739 Magnetopause
THE THICKNESS OF THE MAGNETOPAUSE CURRENT LAYER: ISEE-1 AND 2 OBSERVATIONS
J. Berchem (Institute of Geophysics and Planetary Physics, University of California, Los Angeles, California [illegible])

A survey of the magnetopause thickness over the dayside magnetopause is carried out by using the magnetic field measurements from the twin ISEE-1 and ISEE-2 UCLA fluxgate magnetometers. [illegible]

[illegible]

Saugher, C. R. Chappell, R. G. Shelley, O. Y. Young and A. E. Anderson

Thermal (≲ 100 electron volts) ion observations made with the Ion Composition Experiment on ISEE-1 are combined with plasma density profiles obtained from plasma frequency measurements made with the Plasma Wave Experiment to conduct an investigation of thermal plasma behavior in the vicinity of the plasmasphere during periods of quieting magnetic activity. Normally, the principal thermal ion population in the plasmasphere consists of cold (kT ≲ 1 eV), isotropic distributions with ion species in the order of dominance H^+:He^+:O^+, while outside the plasmapause, the observed E ≲ 100 eV ion distributions usually are field-aligned in structure, have characteristic energies E ≳ 10 eV and H^+:O^+:He^+ order of dominance in fluxes. During periods in which the magnetic activity quiets, the above two regions are separated by a new region in which, at times, low-energy (~1-3 eV) H^+ and He^+ are found flowing along the magnetic field lines. On other occasions following quieting magnetic activity, pancake distributions (peak fluxes at 90° pitch angle) are observed in this region. Other complex distributions have been seen, and these complexities and the limitations of the data coverage preclude a satisfactory simple interpretation. It seems plausible to identify this region as the site of plasmasphere refilling. However, the data presumably also contain evidence of the quiet time rotation of the plasmasphere bulge region into the morning sector.

J. Geophys. Res., Blue, Paper 1A1141

5163 Plasmapause
LONGITUDINAL VARIATIONS OF PLASMAPAUSE RADIUS AND THE PROPAGATION OF VLF NOISE WITHIN SMALL (ΔL ~ 0.5) EXTENSIONS OF THE PLASMASPHERE
A. J. Smith (British Antarctic Survey, Cambridge, ENGLAND) D. L. Carpenter and M. Lester

Simultaneous broadband whistler recordings made during the International Magnetospheric Study (IMS) at the two Antarctic stations Halley and Siple have been used to study longitudinal variations in the radius of the plasmapause observed during local afternoon. In both of the two periods studied thus far, whistler-derived equatorial electron density profiles imply an increase in plasmapause radius between the longitudes of Siple and Halley (Δφ ~ 10°) of ΔL ~ 0.5. Intense VLF noise (~2.5 kHz) was observed at Halley but not at Siple, and by echo analysis its propagation path was identified with that of a whistler component travelling close to the plasmapause within the region of larger radius. This leads to the conclusion that the noise was generated by a gyroresonance instability when energetic electrons (typically 10 keV), drifting eastwards in the plasmatrough, encountered enhanced plasma density in the small extension of the plasmasphere. (Plasmapause radius, VLF noise).
Geophys. Res. Lett., Paper 1L1139

5770 Short-period variations of magnetic field
PROCESSES INFLUENCING THE DIURNAL VARIATION OF THE AL INDEX AND ITS RELIABILITY
Robert E. Holzer (Institute of Geophysics and Planetary Physics, University of California, Los Angeles, California 90024) and James A. Slavin

A study of the average daily variation of the AL index for the years 1966-1974, inclusive, shows that near the winter solstice there is a diurnal oscillation with an amplitude of 45% of the mean. The amplitude diminishes to about 10% of the mean near the summer solstice. The maximum and minimum of the winter oscillation occur at the hours when the stations contributing to the AL index have their maximum and minimum latitudinal coverage, respectively. In an attempt to interpret these results a physical model based upon observational data concerning auroral electron precipitation and ionospheric conductivity has been developed. It is postulated that electron precipitation is the dominant cause of ionization responsible for the conduction of the westward electrojet throughout the year. In the fall and winter months the electrojet is confined to the band of precipitation while in the spring and summer months the contributions of solar ionization permits a latitudinal spreading of the currents. The model predictions are consistent with the observed pattern of change of the average value of AL for the individual AE stations between the winter and summer solstices. It is also consistent with the change in the frequency with which the stations contribute to the determinations of the AL index between the solstices. The results indicate that AL is best suited for estimates of the westward electrojet on a continuous basis during the spring and summer months. An observed increase in the average value of AL with decreasing corrected magnetic latitude is interpreted as due to larger electrojet currents associated with larger magnetic disturbances which produce an equatorward displacement of the polar cap boundary.

J. Geophys. Res., Blue, Paper 1A1145

5770 Short-period (less than 1 day) variations of magnetic field
PC1 EMISSIONS IN THE AFTERNOON SECTOR PRIOR TO THE JULY 29, 1977 SUDDEN COMMENCEMENT
J.V. Olson (Geophysical Institute, University of Alaska, [illegible])

[illegible]

5163 Plasmapause
ISEE-1 OBSERVATIONS OF THERMAL PLASMA IN THE VICINITY OF THE PLASMASPHERE DURING PERIODS OF QUIETING MAGNETIC ACTIVITY
J. L. Horwitz (Physics Department, University of Alabama, Huntsville, Alabama, 35899), C. R.

6115 Trapped particles
ISEE-1 OBSERVATIONS OF O^{++} IN THE MAGNETOSPHERE
J. L. Horwitz (Department of Physics, University of Alabama in Huntsville, Huntsville, AL 35899)

Observations of O^{++} by ISEE-1 have revealed occasional O^{++}/O^+ density ratios of the order unity within the plasmasphere. However, most plasmaspheric O^{++}/O^+ density ratios are generally below 0.3. These ratios agree generally with those seen by GEOS-1. Within the plasmasphere, the O^{++} population appears to be primarily cold and isotropic (as is typical for major ions). Outside the plasmasphere, O^{++}/O^+ field-aligned flux ratios may be of the order of 0.1-0.2, though they are frequently much smaller, and the O^{++} distributions are typically field-aligned. A rare observation of a unidirectional conic in O^{++} is also reported.

J. Geophys. Res., Blue, Paper 1A1120

5776 Trapped particles
LONG-TERM INTENSITY DECREASE IN THE 8-25 MeV PROTON FLUXES AT LOW L VALUES
Daniel S. Paraignault (Physics Research Division, Emmanuel College, Boston, Massachusetts 02115) Ernest Holeman and Robert C. Filz

A five year continuous observation, 1963 to 1968, of the 8-16 MeV proton population, at L < 1.8, had shown a monotonic decrease in this population. We have observed the same proton population from 1970 to 1976, using experiments flown on several USAF satellites (72-1, 83-2, 83-3). These data together with published data from the OIAL satellite show that the decreases in the proton fluxes first observed from 1963 to 1968 have continued unabated, at least until August 1976, and with the same original mean lives. The proton flux at L = 1.35 decayed over the 13-year period (1963-1976) with a mean life, τ, of 5.7 ± 0.5 years. At L = 1.90, τ was 4.15 ± 0.16 years. However, the proton flux at L = 1.20, which had first been reported as constant, started decreasing ~ 1970 to 1976 with τ = 3.07 ± 0.15 years. Possible explanations for this phenomenon can be divided into the two categories of natural and artificial effects. We reviewed these different effects and conclude that most likely we are seeing the decay of the high energy protons redistributed by the "Starfish" high altitude nuclear explosion. (High energy protons, trapped particles).

J. Geophys. Res., Blue, Paper 1A0935

5776 Trapped Particles
A COMPARISON OF CHARACTERISTIC TIMES FOR SATELLITE ABSORPTION OF ENERGETIC PROTONS TRAPPED IN THE JOVIAN AND SATURNIAN MAGNETIC FIELDS
L.L. Hood (Lunar and Planetary Laboratory, University of Arizona, Tucson, Arizona 85721)

The relative symmetry of the Saturnian magnetic field with respect to the rotational equatorial plane results in characteristic times for satellite absorption of trapped energetic protons that are typically one to three orders of magnitude smaller than the corresponding Jovian satellite absorption times. The maximum difference occurs for nearly equatorially mirroring particles. Assuming that the rates of radial diffusion are comparable within the two magnetospheres, the inner Saturnian satellites are more efficient absorbers of inwardly diffusing ions than their Jovian counterparts. Thus, via the mechanism of satellite absorption, the rotational symmetry of the planetary magnetic field may play an important indirect role in determining gross properties of the radiation environment at Saturn.

Geophys. Res. Lett., Paper 1L1160

5777 Andesite-rhyolite
PETROGENESIS OF OCEANIC ANDESITES AND RHYOLITES.
S. Haaldø and T.S. Petersen (Department of Geology, Allegaten 41, 5014 Bergen, Norway)

The andesites of the intra oceanic island arc systems vary in silica content from 49-50% SiO_2 to about 76% SiO_2. The most primitive compositions with about 50% SiO_2, the basaltic andesites, are primary compositions generated by partial melting of the subducted oceanic crust. The oceanic andesites can not have assimilated material from the continental crusts and their petrogenesis afford information about the processes occuring in the Benioff zones. The compositions of oceanic and continental rhyolites are different, reflecting a different source materials for the two andesitic series. (Intra oceanic island arcs, andesite, magma generation).
J. Geophys. Res., Red, Paper 1B0906

5799 General or Miscellaneous-Magnetosphere
PLASMA NEAR IO: ESTIMATES OF SOME PHYSICAL PARAMETERS
M. G. Kivelson (Institute of Geophysics and Planetary Physics, University of California, Los Angeles, CA 90024) and D. J. Southwood

[illegible]

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Physical Properties of Rocks

6110 Elasticity, fracture and flow
FRACTURE-ENERGY OF STICK-SLIP EVENTS IN A LARGE SCALE BIAXIAL EXPERIMENT
S.G. Okubo (U.S. Geological Survey, 345 Middlefield, Menlo Park, CA 94025) J.H. Dieterich

The concept of apparent fracture energy for the shear failure process is employed by many authors in modeling earthquake sources as dynamically extending shear cracks. Using records of shear strain and relative displacement from stick-slip events generated along a simulated, prepared fault surface in large (1.5m x 1.5m x 0.4m) granite block and a slip-weakening model for the fault, direct estimates of the apparent shear fracture energy of the stick-slip events have been obtained. For events generated on a finely ground fault surface, apparent fracture energy ranges from 0.06 J/m² at a normal stress of 1.1 MPa to 0.0 J/m² at a normal stress of 4.6 MPa. In contrast to estimates for tensile crack formation, we find that the apparent fracture energy of stick-slip events increases linearly with normal stress. The results for the slip-weakening model for the stick-slip events are generally consistent with constitutive fault models suggested by observations of stable sliding in smaller scale experiments. (Stick-slip, apparent fracture energy).
Geophys. Res. Lett., Paper 1L1013

6110 Elasticity, fracture, and flow
INFLUENCE OF STRAIN RATE ON DILATANCY AND STRENGTH OF OSHIMA GRANITE UNDER UNIAXIAL COMPRESSION
O. Sano (Faculty of Engineering, Yamaguchi University, Ube, 755, Japan) I. Ito and M. Terada

Uniaxial compression tests have been conducted on Oshima granite under various constant axial strain rates ranging from 10^{-8} to 10^{-4}. The results showed that the strength and the acoustic emission rate increased exponentially with increasing strain rate. The inelastic volumetric strain rate defined by the differentiation with respect to the stress increased with decreasing strain rate.

The redistribution of microcracks due to subcritical crack growth was considered theoretically and the equations derived from the theory was compared with the experimental results. The agreement between the theoretical and experimental results shows that stress corrosion plays not only a major role in the brittle creep under constant load but also dominates the strain rate effects on strength and dilatancy observed in the constant strain rate loadings. (Strain rate, [illegible]).
J. Geophys. Res., Red, Paper 1B1177

6110 Elasticity, fracture, and flow
[illegible]

6110 Elasticity, fracture, and flow
A CRITICAL ASSESSMENT OF ESTIMATION METHODS FOR ACTIVATION VOLUME
Charles G. Sammis (Department of Geological Sciences, University of Southern California, Los Angeles), John C. Smith and Gerald Schubert

We have compared estimates of the activation volume V* based on several theoretical models with measured values in metals, alkali halides, and olivine. The theoretical methods tested include one based upon the empirical correlation between activation energy and melting temperature and several which are based upon simple elastic models for the defect structure. For metals and olivine, the melting relation works well, but for alkali halides, the melting model predicts too large a V* by an approximate factor of 1.6. Of the elastic models, the dilatational strain energy model introduced by Zener (1942) provides reasonable estimates of V* for metals and olivine, but it also overestimates V* for alkali halides. Zener's (1942) assertion that the experimental value of V* should be bounded by theoretical values calculated from strain energy models which assume pure shear (Keyes, 1963) and pure dilatation is supported by the available data for metals, oxides, and alkali halides. These provide upper and lower estimates for the variation of viscosity with depth in the mantle.
J. Geophys. Res., Red, Paper 1B1176

6110 Elasticity, fracture, and flow
UPPER MANTLE VISCOSITY DERIVED FROM THE DIFFERENCE IN REBOUND OF THE PROVO AND BONNEVILLE SHORELINES: LAKE BONNEVILLE BASIN, UTAH
O.E. Passey (Division of Geological & Planetary Sciences, California Institute of Technology, Pasadena, California 91125)

Twenty-four new field measurements of elevation of Provo-level and Bonneville-level shoreline terraces provide data for reanalysis of isostatic rebound in the Lake Bonneville basin. Analysis of the differential rebound between the Provo shoreline (maximum rebound of 41 m) and the Bonneville shoreline (maximum rebound of 69 m) requires that the latter be an equilibrium shoreline. Within the measurement errors, the Provo shoreline formed after the elastic lithosphere had attained at least 91% equilibration to the removal of the water load between the Bonneville and Provo shorelines; within the errors, the Provo may also represent an equilibrium shoreline. From the new data presented in this paper, the best estimate of the upper limit to the effective viscosity of the uppermost mantle, assuming a half-space model and a 1000 year time interval between the Bonneville and Provo shorelines, is 1 x 10^{19} N sec m^{-2} (1 x 10^{20} poise). In addition, comparison of shoreline rebound profiles, for both shorelines, with theoretical profiles from plate flexure models indicates that the mean flexural rigidity of the basin and Range lithosphere is 1 x 10^{23} N m, or slightly less. (Viscosity, upper mantle, flexural rigidity).
J. Geophys. Res., Red, Paper 1B1171

6190 Instruments and techniques
AN INTERFEROMETRIC TECHNIQUE FOR MEASURING VELOCITY AND ATTENUATION IN MOLTEN ROCKS
Y. W. Katahara (Hawaii Institute of Geophysics, University of Hawaii, Honolulu, Hawaii 96822), C. S. Rai, M. H. Manghnani and J. Balogh

[illegible]

of the method was tested at room temperature by compressional wave measurements on water, mercury and carbon disulfide. Velocities were found to be accurate to within 0.3%. Values of the specific dissipation factor (Q^{-1}) as low as 10^{-3} can be resolved for a liquid such as water with a low acoustical impedance, whereas Q^{-1} values as low as 10^{-4} can be recorded for high impedance liquids such as mercury. Q^{-1} values obtained on carbon disulfide agree with previous work to within better than 0.001. [illegible] organic polymer show that [illegible] can be made, and that Q^{-1} values up to at least 0.2 can be measured by this technique. The method has been successfully used to study [illegible] to 1500°C. Sources of error and possible improvements are discussed, and the method is compared to previously used techniques. The method has the potential of measuring [illegible] tion in partial melts and solids. (Velocity, attenuation, rock melts, ultrasonics).
J. Geophys. Res., Red, Paper 1B1219

Planetology

6510 Atmospheres of Planets
NITROGEN ON JUPITER: A DEEP ATMOSPHERIC SOURCE
R. Prinn (Dept. of Meteorology and Physical Oceanography, MIT, Cambridge, MA 02139) and J. Olaguer

A study of irreversible reactions involving molecular nitrogen on Jupiter indicates that vertical motions are sufficiently rapid in the deep atmosphere to transport large amounts of N_2 from the 900 - 1700°K levels where it is stable up to the cold visible regions. Both homogeneous gas-phase and heterogeneous iron-catalyzed reactions between N_2 and H_2 were considered. We predict N_2 mixing ratios of 0.1 - 1 ppmv if catalysis is effective and up to 10 ppmv if it is not. Thus N_2 may be the most abundant nonequilibrium species in Jupiter's troposphere and potentially detectable by the neutral mass spectrometer which will be on board the 1986 Galileo Entry Probe. (Nitrogen, Jupiter, Saturn)
J. Geophys. Res., Green, Paper 1C1121

6510 Atmospheres of planets
TITAN'S UPPER ATMOSPHERE: COMPOSITION AND TEMPERATURE FROM THE EUV SOLAR OCCULTATION RESULTS
G. R. Smith (Earth and Space Sciences Institute, University of Southern California, Tucson Laboratories, 1625 East Ajo Way, Tucson, Arizona 85713), D. F. Strobel

The temperature and composition of the upper atmosphere of Titan have been inferred by observing an occultation of the sun by Titan, using the Voyager 1 Ultraviolet Spectrometer. The temperature is 176±20 K near the evening terminator and 186±20 K near the morning terminator. The major constituent is N_2 with a density of 2.7 [illegible] at 1840 km. The mixing ratio of CH_4 is [illegible] at a radial distance of 3700 km near the evening terminator where [illegible]

[illegible]

6510 Atmospheres of planets
EUV EMISSIONS FROM TITAN'S UPPER ATMOSPHERE: VOYAGER 1 ENCOUNTER
B. R. Strobel (Naval Research Laboratory, Washington, D.C. 20375), D. E. Shemansky

Analysis of Titan's EUV emission spectra obtained by the Voyager 1 encounter demonstrates that electron impact on N_2 above 3600 km accounts for the bulk of the observed emission. [illegible] upper limit mixing ratios at 3900 km on Ar, CO, H_2, and Ni of 0.01, 0.01, 0.06, 0.1, respectively. Magnetospheric electrons interact with Titan's upper atmosphere [illegible]

J. Geophys. Res., Blue, Paper 1A1209

6560 Meteorites
REFRACTORY SPHERULES IN THE MURCHISON METEORITE: ARE THEY CONDRULES?
I. D. Macdougall (Scripps Institution of Oceanography, La Jolla, California, 92093)

[illegible]

Geophys. Res. Lett., Paper 1L1146

6575 Surface of Planets
A SIMPLE MECHANICAL MODEL OF VALHALLA BASIN, CALLISTO
H. J. Melosh (Dept. Earth & Space Sciences, SUNY Stony Brook, Stony Brook, N. Y. 11794)

The Valhalla basin on Callisto is a multiringed structure which extends over much of the satellite's surface. Although its appearance differs in detail from lunar multiringed basins, its origin may also be attributed to lithospheric fragmentation accompanying collapse of the transient crater formed by an impact event. This paper explores the mechanics of the collapse process by treating the lithosphere as a thin elastic-von Mises plastic sheet (plane geometry) or shell (spherical geometry). Flow of the underlying asthenosphere inward toward the crater cavity induces plastic failure of the lithosphere and produces a characteristic pattern of faults in the disrupted lithosphere. The pattern and extent of faulting is a function of a single dimensionless parameter which involves the strength and thickness of the lithosphere, the crater depth and diameter, and the surface gravity of the planet. [illegible]

J. Geophys. Res., Red, Paper 1B1152

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